INDUSTRIAL CURIOSITIES

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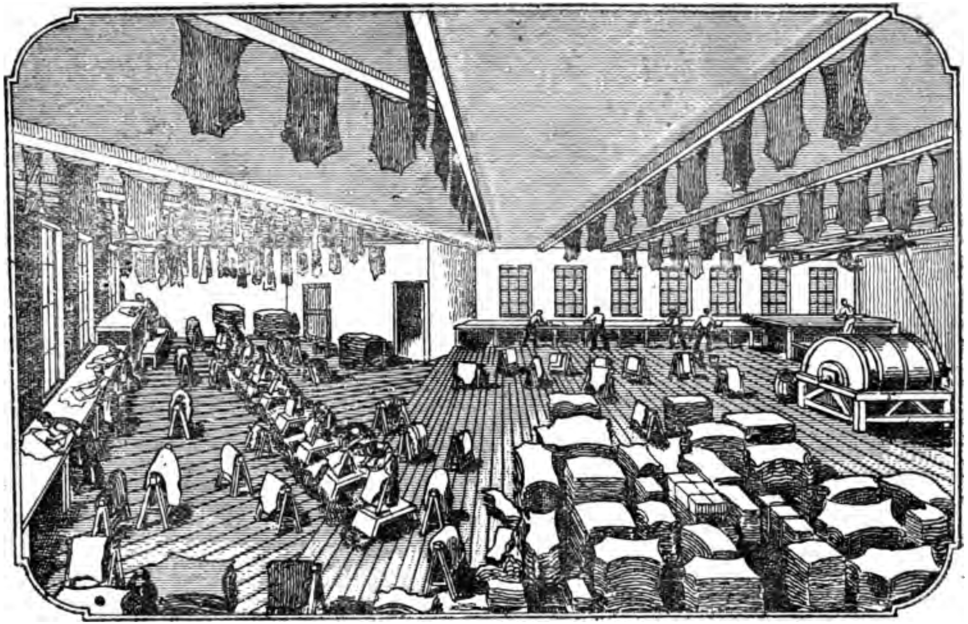

FRONTISPIECE. *Sharing and Finishing Sheepskins.*

INDUSTRIAL CURIOSITIES.

Glances here and there in the World of Labour.

WRITTEN AND EDITED

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No human pursuits make any material progress till science is brought to bear upon them. We have seen, accordingly, many of them slumber for centuries upon centuries; but from the moment that science has touched them with her magic wand, they have sprung forward and taken strides which amaze and almost awe the beholder.—*Prince Albert's Golden Precepts.*

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PREFACE.

Some of these chapters have been published in a condensed form in *Good Words* and other magazines and journals. An idea of connection between one and another, more or less strong, was felt as progress was made in the preparation of them; and now that they appear in volume form, this may be more evident to the reader. The author trusts that the same favour which was accorded to them in their first form may be bestowed upon them now.

A. H. J.

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LEATHER.

I.—History and Antiquities.

Leather has a long history. It has even been glorified by poetry. Not to mention songs to St. Crispin, and such ballads as that of "Robin Hood and the Tanner," D'Ercilla wrote an epic poem on Leather, of which Mr Carlyle has condescended to speak.* On the tombs of Egypt, amongst the sculptured treasures, the tanner may be seen sitting amid his pits, surrounded by tools much as they are still used at the present day. In the British Museum real tanned Leather sandals are to be seen, such as are known, from paintings and sculptures, to have been worn in Egypt more than 3000 years ago. This was before the date of any scriptural reference to Leather, such as that in 2 Kings, i. 8, where Elijah is described as "having a girdle of leather about his loins." The tanners were a class in a sense proscribed by the Jews, who compelled them to make their tan-pits outside the walls; and it is clear

* See Macvey Napier's Correspondence.

that, in ancient Thebes, too, they were compelled to work in a place apart.

Leather was, undoubtedly, one of the very first bits of manufacture—rude, yet suited to its purpose; the use of bark for hardening and preserving skins having no doubt been practised in pre-historic times. Even our progenitor—the ancient Briton—used a strong hide thong to throw his stones with, and was scantily clad in Leather—anticipating the odd desire of George Fox, the founder of Quakerism.

Many guesses have been made about the way in which the art of tanning originated amongst our forefathers, who lived in the deep woods and passed their days in fishing and hunting and fighting with each other. Some say that they knew nothing of tanning, properly speaking, till the Romans came; and that it was introduced by them, which is unlikely; and others say that it was found out by happy accident and observation much earlier than that. Mr Sutton, who has delivered a very interesting lecture on Leather, to which we have been indebted for some facts, says on this point:—

"It is well known that the ancient Britons used boats of basket work, covered with the hides of the wild animals which then roamed at large through the immense forests of the island. Further than this, they were in the habit of covering those hide-bound boats with strips of bark, as a protection against sharp rocks, stones, &c., and it is just possible some poor ferryman may have discovered that where the water and the bark came in contact with

the hide an unknown action took place which in time rendered the pelt more tough and durable. Another writer suggests that tanning may have been discovered in the following way: In those early times, before draining was practised, there would be in the recesses of the forests many pools of stagnant water, which, through the course of years, would become impregnated with tannic acid, owing to the leaves and acorns falling from the trees above. Now, when the raw skin coats then worn by the inhabitants of the island became hard and brittle with the action of the sun, it is quite probable they would sometimes be left to soak in these pools to regain their natural softness and pliability; and if on any occasion the owner of one of these skin garments forgot the whereabouts of his property he would, on discovering it again, perhaps three months after, find it converted into a species of tanned Leather. Whether this theory is correct or not, I am unable to say, but it is within the range of possibility, and therefore worthy of our notice and attention."

Be this, however, as it may, we find Leather in common use in our islands at a period immediately after the retirement of the Roman conquerors, and its manufacture was left entirely free and untrammelled by State restrictions up to the period of the Plantagenets, who passed acts containing such foolish provisions that, to oppose their enforcement, the Leathersellers' Company was started in 1382. A century later, however, the trade seems to have ranked of some importance, for the patent

granted in the year 1483 by Henry VII. says "That every one taking up the freedom of the Skinners' Company shall be presented to the Lord Mayor of London." This royal attention may, however, have sometimes brought unwelcome notice also; for down to a late date Leather manufacture was pursued by many restrictions and taxes, and was often included in tiresome sumptuary regulations. Taking another stride of a century, we find curriers figuring as bad fellows indeed, and meeting with the punishment they deserved. It is very odd to read that in England in the sixteenth century complaints were made that skins were tanned in three weeks (thus unconscionably shortening the period of use and wont, which had been more than a year), and that in consequence an Act was passed in 1548, prohibiting tanners from selling hides that were not attested to have been nine months in the tan-pit. In those days time was gained without the scientific helps that count for so much now, and we are not surprised that the Leather so quickly produced did not wear well. At this time it would seem that Parliament was too much concerned about Leather. Hume deprecated the attention given to it when writing of the year 1571. We find him saying that Parliament dared not touch the Queen's prerogative, but might only employ itself in making laws for the preservation of pheasants and partridges, the milling of cloth, or *the due tanning of Leather;* showing that legislation tended in those days to run in the same grooves as it occasionally does somewhat retrogressively now. History indeed repeats itself. But then, as now, it

was a hard and almost hopeless task to make men moral by Act of Parliament. This will be conclusively seen by these facts. In a passage in Robert's "Social History of the Southern Counties of England," we read, "In 1597 there were complaints of the Leather being badly dressed, and so not wearing well when made into shoes. The jury of Lyme Regis represented the shoemakers as faulty, and not causing their Leather to be well curried, upon which they were fined 1s. each, in order to make them look better after the curriers." It was without success, however; for again in the same year they were fined 6d. each, and in the year following, the incorrigible curriers were fined 1s. 8d. each. The curriers of 300 years ago were thus much the same as those who have come after them, in not always doing justice to their work. We must bear in mind, too, that 1s. 8d. was a serious matter at a time when a sheep was worth from 4s. 6d. to 5s., and wages in proportion. Further on, in the same article, we read, "It was the custom to fix the wages of master mechanics, tradesmen, skilled workmen, artificers, journeymen operatives and agricultural labourers, &c., at the Easter Sessions. At the Dorset Easter Sessions of 1563 the class of servants to which the shoemaker and tanner belonged were not to have above 50s. for a year's wages, and for livery 6s. 8d., meat and drink. He who was able to have the government of the rest of the servants was not to have above £3., and for his livery 10s., meat and drink." Butler, the great satirist, writing about 1650, introduces a character into one of his works who was so often kicked he could tell the difference

between calf-skin and cow-hide Leather. In the Book of Trades, published about 1752, we find the following remarks :—"Tanning is reckoned a genteelish business, but owing to the hard labour and being much in the wet, it requires strong and hearty lads to be brought up in it, a journeyman earning 10s. weekly, and a master cannot well set up in it under a capital of £500."

And the jealousy of rival guilds, which did something in old days to secure the division of labour, if nothing more, is also seen in the history of Leather. In 1439 tanners were prohibited from being shoemakers; while in 1562 butchers were precluded from becoming tanners under a penalty. Some of the petty restrictions which surrounded the Leather manufacture actually remained until 1830, when they were completely removed by an Act of George IV. Free trade in tanning, then introduced, gave an immense impetus to the application and extension of the chemical discoveries which had been made by Sèguin in 1795, and by Sir Humphry Davy in 1803. Sir Humphry, whose curiosity in all scientifico-industrial matters was unbounded, spent the leisure hours of fully two years in investigating the scientific questions involved in tanning, and in the attempt to find the most perfect element for the purpose. He was liberally supplied with gifts and loans from the ample stores of Sir Joseph Banks, who had just completed his great voyages; and the result was the valuable paper in the Transactions of the Royal Society, stating the proportions of tannin in every class of tree; and many possible combinations as substitutes. These

applications of chemistry have rendered the process more and more complicated. The old method of tanning was to place the hides and the ground bark in the tan-pits in alternate layers and then fill up with water, renewing the bark every few months. By this process some two or three years was required to produce perfectly tanned Leather, and, in consequence, the cost of manufacture was exceedingly high. These chemists introduced the plan of using strong solutions of bark, which were obtained by exactly the same process as the housewife adopts when making tea, and the inventor anticipated that by means of these solutions Leather might be produced in about as many days as it formerly required months to produce. But experience showed that the more slowly the astringent substance was allowed to operate on the hide the better was the Leather produced, and, consequently, whatever modifications may find their way into this manufacture, time, as the lawyers say, must always be the essence of the matter. Thus, though a variety of other materials have been introduced from time to time and are still in use for tanning purposes, oak bark has never found a rival. Its value as a tanning material much depends upon the time of year when it is gathered. The bark cut in the spring is found to contain at least four times the quantity of tannin to be extracted from that cut in the winter. Young oak tress also yield more valuable bark than old ones.

The dependence of this country for a very large portion of the supply of hides and skins from abroad, in some respects modifies the treatment in manufacture of a good

deal of Leather; as can be conceived when we mention that these hides are salted in order to preserve them for considerable periods, and that from salted hides the very best kind of Leather cannot possibly be made. It is a comfort to know that if there is nothing like Leather, our own country must still produce the best, simply because of the fact that only home-produced hides can be taken straight from the animal's back to the tan-pit. Salt is good; but, in this particular case, the thing salted loses somewhat of its savour and strength. Some idea of the immense trade in Leather may be realised from the following statement:—

There are in Great Britain and Ireland seven or eight million head of cattle. But these do not afford a supply of Leather sufficiently large for the numerous uses which it serves. We import hides from Lithuania, and other provinces of Russia, where the cattle run wild in the forests, and in Paraguay the vast herds which range the boundless plains are pursued and skinned, while the rest of the animal is of so little value that the carcase is left to rot upon the ground. The value of articles made of Leather is nearly twenty millions per annum, and shoes take more than one-half that amount. Leather is not an article of export, for other nations can supply themselves more cheaply than we can supply them.

In the higher departments of the work of Leather-making, the spirit of fine art comes so largely into play now, that we are quite sure few of our readers, when they see a hat-lining, a pair of gloves, or of kid boots, not to

speak of commoner productions, have any idea of the many processes and kinds of manipulation it has gone through before reaching that stage. They may, therefore, be interested in following a short description of some visits paid to large establishments for the manufacture of Leather.

II.—At the Fellmonger's.

It is sometimes difficult to get at the reasons which have led to the concentration of certain industries in particular places or districts, but there is no mystery in the case of tanning in London.

Not that such localising pressure was ever used, as was brought to bear among Jews and Egyptians. The law of convenience and economy was, perhaps, as fully studied in the matter as though there had been. In Bermondsey is the head-quarters, and the reason is that Bermondsey was very convenient for supplies of water from the Thames: for it is hardly needful to say that the tanners are more dependent on water than are persons in most other industries. We accordingly betake ourselves to that quarter. First we must peep in at what is called a fellmonger's yard, and are most obligingly shown over the works of Mr Edward Cordery. Here the hides or skins come in large loads from the slaughter-houses, with the wool or hair still upon them. The chief work here is to remove the wool or hair, and all is preparatory to this. The skins are spread out on blocks and beaten with rough mallets to loosen the clotted blood or any dirt that may adhere, and then they are thrown into large tanks and washed in pure water. After

that they are spread out and painted over in the inside with a thickish liquid of lime, and hung up to dry to a certain extent in the open air, and after that in heated presses. We may remark here, in passing, that various attempts have been made to do away with the use of lime in the earlier stages of Leather-making, because it is found so materially to reduce the weight of the skin, but not

Unhairing the Skins.

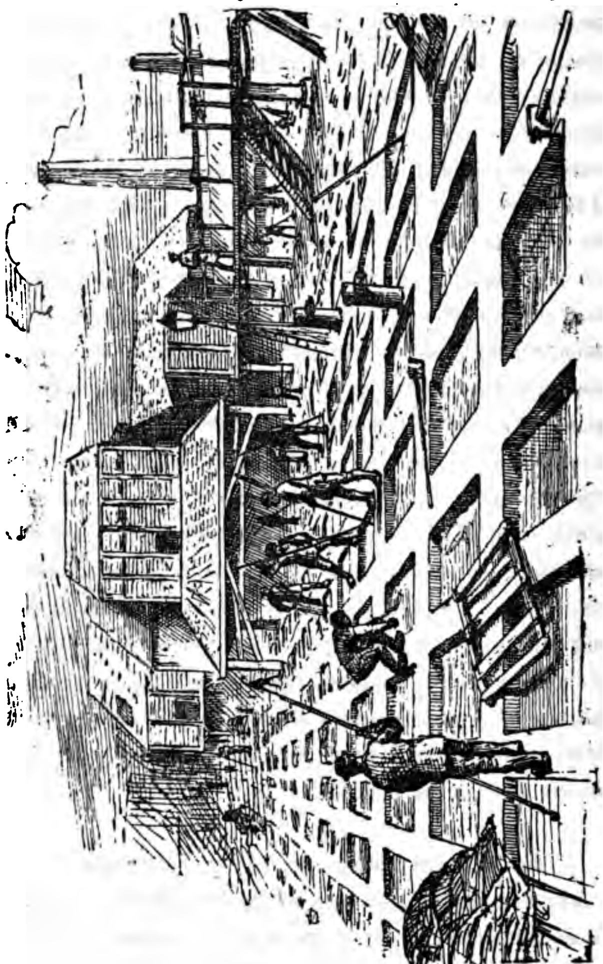
successfully. The skins are next handed to men who spread them over a block, and with a few passes of an

instrument like a giant spoke-shave, easily remove the wool or hair from the skin already well loosened from it. These men know by the class to which the skin belongs, the quality of the wool or hair from off each part — back, breast, or top of the legs—and roughly assort as they detach it, by throwing it into one or other of a range of boxes before them. The hair from hides is of use as well as the wool from sheepskins. We observe that the men are very careful to remove every bit of white hair first, putting it carefully aside in one place, and for this there is good reason. The white hair is much more valuable than the coloured: it is used for making felt and for other purposes, whereas the dark-coloured hair can be used only in lime and plaster, and fetches comparatively little; but all is used, the "waste" in a fellmonger's yard being very slight indeed. Small portions of the outside of the skin or hide, that may be cut off in the process, are carefully gathered together and sold for the manufacture of soap, glue, &c. The wool, before it leaves the fellmonger's yard, undergoes further very careful processes of picking and sorting; but to follow up the wool will fall to another chapter. The skins are now put into lime-pits, where they lie for a few days, and then they are ready to go to the tanners, whither we must follow them.

III.—Heavy Hides and Heavy Leathers.

And first for the treatment of the heavy oxhides, which Messrs Hepburn disclose to us in a yard several acres in extent, with bark-pits showing Leather in all stages of the

process, and fished out of nearly all depths of dark and turbid, if not stormy, waters. Their machinery is,



The Bark-pits.

perhaps, as complete as possible; as respects much of the work of preparing Leather for mill-bands and water-hose, as well as of tanning. The "pelts," as the hides are at this stage called, are first washed and then conveyed to the tan-pits, which are arranged in what are technically known as "Shifts." Each shift consists of eight pits containing liquids of progressive degrees of strength. The hides, before tanning, are usually cut up into "Butts," by which is meant the thickest part of the hide divested of both the shoulders and the bellies, or else into "Backs," in which case the shoulders are retained. The butts are tanned in sets that are known as "Packs." The tanning liquid is being constantly changed in the pits by means of pipes and pumps forming a machinery as intricate and imposing as that of a brewery, and the butts are shifted every day or two. The first shift is known as the "Green shift," and the second as the "Forward shift." In each shift there are what are known as five "Floaters," that is to say pits where the skins are allowed to float as best they can in the tanning solution, and three that are called "Dusters," because in these the skins are each separately dusted with oak bark ground small, and then placed in layers one above the other. The entire process of tanning in these pits occupies from four to six months.

Sometimes the hides, before passing to the tan-pits, are subjected to a process called splitting, which is a very ingenious method for reducing the hide to a uniform thickness throughout. It is done by machinery. Four men are required to superintend the operation, which is,

however, very quickly performed, a large hide being split in two in about five minutes. The process is accomplished by means of an oscillating knife driven by steam power. It divides the skin in two portions with the greatest nicety. The grain side hide so split is known in the trade as a "Split Hide," the flesh side being sold simply as "Splits," and these, of course, are used for inferior purposes, such as insoles. The process of splitting, naturally leaves all the pores of the skin exposed, and consequently more susceptible to the action of the bark.

When the process of tanning is complete, the butts are next slowly and completely dried, and are then submitted to a process known as striking. This is for the purpose of compressing the Leather to give it additional firmness and density. Very powerful machines are used for this purpose, but we believe that on all the best sole Leather the striking is still performed by hand. A rolling machine, consisting of heavy gun-metal rollers traversing a zinc bed, is next brought into operation to give a smooth surface to the Leather, which is then completely finished for the market. It only remains to be weighed and sent out to the merchant.

It is said that no act or uttered word of man goes unrecorded; that the very air is a great register; and that every act writes inevitably and with more or less of visibility to the ordinary eye its own memorial. A tan-yard is an odd place to suggest such mystical moralisings; but so it is. Some indelible records of thoughtless cruelty were shown to us here—records as little to be welcomed

from an economical and commercial as from a philanthropic point of view; for they lowered values considerably. On some of the hides ugly gashes running into long tears on the upper surface of the skin and breaking its smoothness, were seen; and these on inquiry we found were "Goad Marks," produced by the brutality of the drovers who use sticks with sharp steel ends. These not only disfigure and deteriorate the value of the skins as articles of commerce—appearing as they usually do on the most valuable portions of the hide—but must also inflict great misery on the poor animals. We commend to the attention of the Society for the Prevention of Cruelty to Animals the fact that large numbers of the cattle driven through our streets are thus wounded by the cruel use of this steel instrument. And this sort of thing is going on every day of the week. Those who are at all sceptical on the subject have only to pay a visit to the New Cattle Market any Sunday evening in the year, while the bells are calling all good people to church: the cruelties that are habitually practised there call loudly for special legislative interference. Though much is done, yet much remains to do.

In the preparation of heavy brown harness Leather, linseed oil is rubbed into the skin after drying, and then the skin is beaten, the process being repeated till the due consistency and colour are gained; then it is rubbed down with a clean dry rag; or, to heighten the lustre, with sweetened milk, or, better still, with a solution of crocus. For bleached harness Leather the hides are rubbed on the

flesh side with a mixture of sheep tallow, borax, and linseed oil.

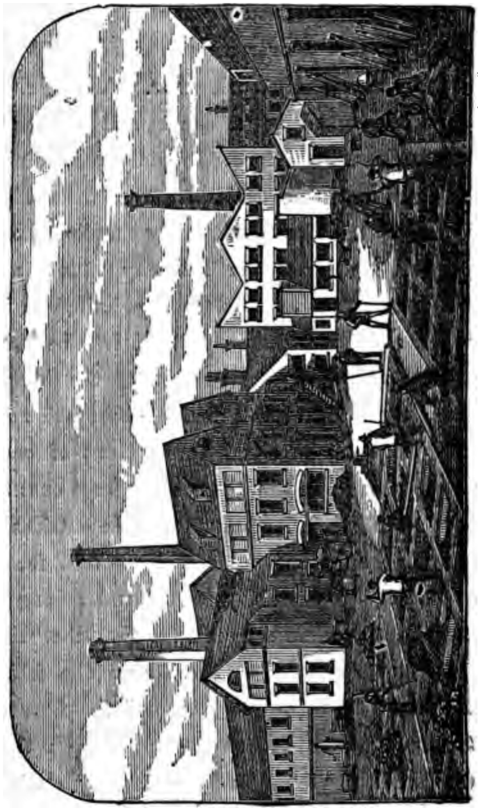
Great numbers of the heavier sheepskins are either tawed with alum and salt, or tawed in alum and salt after the bark treatment, in view of being used as aprons for blacksmiths, workers at furnaces, and others employed near fires—the fire not being so liable to injure Leather which has been so treated as that which has only been tanned in bark.

IV.—Fine Sheepskins and Lighter Leathers.

Messrs Bevingtons and Sons, of Neckinger Mills, are one of the oldest and largest firms in the trade, and owing to their kindness, and the friendly attentions of Mr Samuel B. Bevington, we may with all justice say that we could hardly have seen the various processes of the finer Leather manufacture under more favourable conditions than we did at their extensive and well-managed works. Here the sheepskins, after inspection, are again put into pits, where they are subjected to the action of lime and water for about a fortnight, being drawn up at intervals and passed successively into stronger solutions of lime.

They are next submitted to the process known technically as *fleshing on the beam.* This means that they are struck out on a sloping block or beam, having a convex surface whereon the skin may be conveniently laid, and are gone over by a rough two-handled knife to detach any of the particles of flesh that may have been left after flaying. The texture of the skin is thus opened also as a pre-

liminary to processes to come. They are then laid on the top of the others in piles for a day or two.



The Lime-pits.

The next stage through which many of the finer skins pass as well as the strong hides, is that of *splitting*. In a machine room we see several splitting knives at work—a refined and more intricate, and, therefore, more interesting,

edition of those adopted for the hides. This machine, like most others, has by gradual stages reached its present form. The skin is fixed by steel hooks attached to a roller, and is passed over a straight edge, being pressed against it by means of a spring bar. A very sharp horizontal knife, worked by a crank and connecting rod, oscillates backward and forward rapidly, thus dividing the skin as it is drawn by the roller over the straight edge. The invention is at once admirably simple and admirably perfect, and illustrates the economy which machinery brings into manufacture. Before this knife was invented, many of the skins for fine work could only be thinned by paring down; so that a great portion of the skin was lost. Nowadays, by means of this machine sheepskins can be so split that two skins practically are got out of one. Sealskins are also split, and in the case of large ones the flesh side is tanned for inferior purposes. The outsides of small ones, however, are of no value, and are sold for purposes of manure, being especially in demand among the hop growers. And here we may remark that the "fleshings" from the tanner's yard, like those from the fellmonger's, are sold for making glue and size, and the finer sorts for gelatine, so that not a few of us may, through the palate, have been indirectly brought in contact with the tanner's yard, though we knew it not. Fine perfumes are got from dirty and offensive materials, and so contributions of sweet foods may be gathered from unlikely corners. These fleshings are sometimes worth as much a £7 a ton for this purpose. The *split* sheepskins have the technical name

of "skivers," while the whole or unsplit ones are called "roans"—which may impart some meaning to words that are to be seen on the signs of Leather merchants.

The sheepskins intended for "roans" are then *tumbled*, *i.e.*, they are thrown into gigantic revolving tubs through which water runs. These tubs or "drums" contain perhaps ten dozen skins at a time, and it is certainly a striking sight in such large manufactories as that of Messrs Bevingtons and Sons to see a row of these ponderous wheels revolving with their heavy contents. Inside they are constructed rather like a washing-machine, having shelves arranged in somewhat the same way, and against these shelves the skins are driven and dashed with great force several times in each revolution. The next process is called *puering*—the skins being immersed in a solution of dog's dung, and worked on the beam with a two-handled knife. The "Finders," who in old days were a most essential part of a tannery, now, like Othello, find their "occupation gone," or going; since certain chemical elements have been found to effect the same end on the skins and as cheaply. A slate knife is also used in the process to remove the fine hairs which may yet remain.

The next stage is the *pressing*, some twenty dozen skins being put in a hydraulic press with metal plates between them. The purpose of this is to squeeze all remains of fatty matter completely out, and when the skins are taken from the press it is evident to the eye how much in bulk has been lost through the extreme thinness that they now present.

The skins are next *drenched,* which means that they are thrown into a mixture of bran and water—which has the effect, by its fermentation, of opening the pores of the skin and softening it. But here we must pause to explain that now the skins divide themselves into two great classes (all kinds having, with a few modifications, up to the present followed the course described)—those which are coarsest in quality and are to be devoted to commoner uses being sent with the sealskins and hides to the bark pits, to go through the somewhat slow process of tanning there; while the finer skins have a different destination, involving a far greater and more interesting variety of treatment. Bark, though its stringent properties render it most efficient in tanning, has the disadvantage of leaving a colour on the skin, and therefore the skins that are meant to be white or to be dyed in fine colours must not be submitted to treatment by it. After casting a glance at the large bark-pits, where men are fishing up skins out of many feet of water thick with bark, and laying in others, we turn away, and follow the processes in the case of the finer ones.

These are taken and tumbled once more, struck out again, and submitted anew to the slate knife, lest any hairs should still remain; then they are put in a weak solution of sulphuric acid, then washed in water once again. This process is called *sweetening,* because its intention is to take the "sour acid" out, and to open the skin for the reception of the tanning matter.

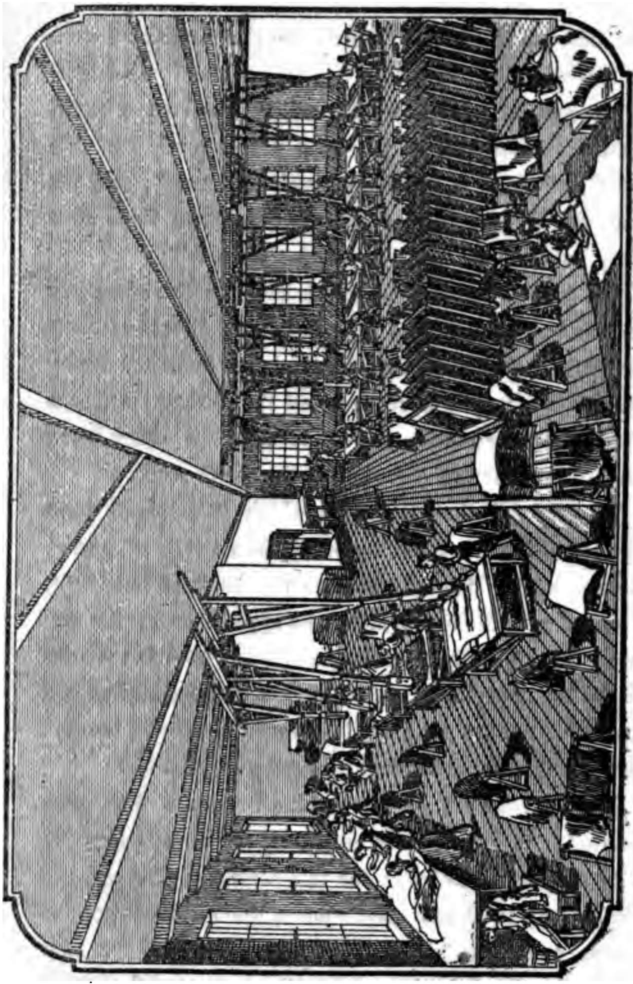
Our next visit is to a chamber the sight of which some-

what surprises us. Here are dozens of women and girls engaged in sewing up what appear to be skin bags, somewhat like big water-bottles used in the East, and at first we cannot imagine of what use their work can be. It is essential, however, in tanning with *sumach,* as we shall immediately see. About eighteenpence per dozen is paid for the sewing of the skins into these bags. When we step into the next department the reason of the bag-sewing becomes fully apparent. Here we find men engaged in filling up these bags with a brick-brown coloured liquid, and afterwards throwing them down to float about in it in big round tubs. The *sumach,* which is scientifically called *Rhus coriaria,* belongs to a genus of deciduous trees, and the ground leaf from it is fine and soft, and for this process is simply mixed in water. The bags are kept floating about in the sumach liquor for some hours — generally between three and four — after which the water is squeezed through the pores of the skin by the pressure of their own weight on the framework over the one side of the tub on which they have been piled while still filled. The whole tanning process in this case only requires some twelve hours—a great improvement certainly on the bark in all its forms, which needed weeks, and sometimes even months. After this process of tanning the skins are ripped open, washed out carefully so as to remove all the adherent sumach, struck out on a table, and dried in lofts by the action of the air; when thoroughly dried they are technically known as *in the crust.*

Having now described the process of tanning the *roans*, or unsplit sheepskins, we will take up the *skivers*, or split sheepskins, from the splitting engine.

Being of more delicate texture and substance than the roans they are not subjected to any of the more violent processes required to soften and cleanse the former. Instead of being *tumbled* they are merely washed in clean water, after which they go through the processes of *puering* and *drenching* as already described. The pressing for the extraction of the grease is omitted in their case. On account of their thinness it is not requisite; the process of *puering* being quite sufficient to remove all traces of grease. They are then tanned in open vats with sumach, but without being sewn into bags, and after being washed in water to remove the superfluous sumach, are dried in the lofts by the action of the atmosphere.

Here again we encounter a parting of the ways—a division in the destination of the products we have followed thus far. Some of the skins now go to the dye-house. others—the white ones—pass on to "finishing," undergoing a preparatory process, however, in the dye-house. This consists in an application of sugar-of-lead and sulphuric acid, the purpose of which is to bleach them. Those which are to be coloured are also put through this very dilute sulphuric acid, as it enables them to take on the colour more easily and more perfectly. Plaster of china clay is then put on the white skins to whiten them more thoroughly, and after that they are rubbed with the white of egg, and then rolled. This gives that shininess which



Graining, Dicing, &c.

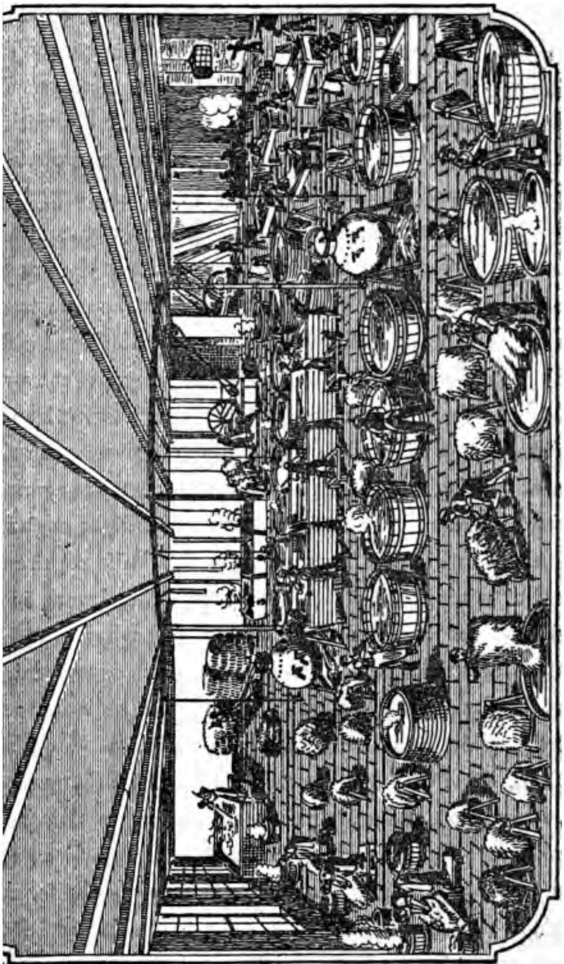
is found on white hat-leathers, for example. The peculiar markings called "grain," which are also frequently seen, are produced by "graining" or "finishing" machines, which pass a grooved wooden wheel, fixed on a shaft, rapidly over the surface put at a proper level, the skin being shifted as is needful at each movement; and the same process is applied to all finer Leathers that, after being finished, are what is called "grained."

The process in the dye-house is one in which chemistry plays so important a part that it is difficult to describe it familiarly. Suffice it, that logwood and ordinary dyeing materials are largely in request, and that furnaces and vats of peculiar construction are to be seen, the skins being plunged into the vats according to the colour required.

We may say that Hématine, which is prepared from logwood and is the colouring principle in a state of purity, is much used. When logwood-extract has been long kept, a sort of metallic lustre makes its appearance on the surface. This is really hématine, which has been formed out of the hæmatoxylia by a slow process of fermentation and atmospheric action; and this is of essential value in bronzed leathers, the simple logwood producing a bluish tint.

To obtain the red colour, cochineal takes a first place naturally; it is helped by sorrel, by salsola ericoides (an alkaline plant plentiful in the salt deserts of Tartary), by bazil wood; to obtain other colours there are solutions of saffron and sumach; for the tanning of skins for finer colours too, the following are sometimes used: solutions of apricot, myrtle, rose-chesnut, cherry, hazel, ash, tormentil,

w, poplar, plum, beech, alder, black willow, olive, uefoil, bistort, ladies' mantle, water flag, mimosa,



In the Dye-house.

souchong tea, and many others. The bark is the portion of these plants used, where bark is; it is sometimes the inner bark, sometimes the entire bark. The bark and leaves of the Eucalyptus tree have been recently found of great service, and the use of it will probably increase.

One of the most important departments of the work is certainly that called "shaving," the last process to which fine skins are subjected by the knife. The expertness required in it is such that it not improbably gave rise to a common slang expression derived from the name. "Shaving" may be called the fine art of the Leather trade, for it certainly requires great skill. After the dyed skins have been brought from the dye-house, they are conveyed to a room where some half-a-dozen men are at work leaning over a block or beam, on which a skin is thrown wrong side up, and bringing a knife of very peculiar make across it at certain parts. The knife has the edge at right angles to the blade, and to get the proper edge on a knife requires in itself a training. The purpose of the shavers' work is to equalise the thickness of the skin throughout, and to remove any fault in it. An unskilful "shaver" might speedily destroy much property, and render null and void all the labour that had already been expended on the articles. One of the craft modestly urged its claims upon us, saying that the seven years' apprenticeship demanded was by no means too long; for during the first two years the youth was merely learning to handle the knife, and could not be trusted to put it on a fine skin; and from what we saw we are inclined to think he was right.

Shamoy skins are, as every one knows, largely used for many purposes—for inside linings of gloves, &c., and for cleaning purposes in many departments. It is not derived from the skin of the chamois, as is sometimes ignorantly supposed, from the sound of the name, which results from the process, but from the flesh-side of the sheep skins which have been *split*. The skins, after having been passed in the ordinary way through the earlier processes of washing, &c., are soaked first in lime water, and next in a mixture of bran and water, or in a weak infusion of sulphuric acid, after which they are beaten in a mill until no moisture remains in them. Fish oil is then poured over the skins, which are again beaten till they are thoroughly impregnated with it. This is done over and over again until the skins can receive no more oil; and then they are hung for a short time in a room heated up to a certain temperature. They are then carefully washed in a solution of potash, which removes any oil that may still remain about the Leather; and thus we have the shamoy skin of daily use.

The drying processes in connection with Leather-dressing are of so great importance that a word may be allowed on them. In such an establishment as that of Messrs Bevingtons and Sons, which occupies over five acres of ground, and actually seems to have a little Thames running through it, a very large proportion of the buildings is devoted to drying lofts, some of which are unheated, and others kept at different temperatures. The shifting of the skins from loft to loft in the process of drying is one of the most

urgent parts of the work, requiring unceasing care and watchfulness. In the lofts where the highest temperatures are necessary for drying, the men charged with the duty of looking after the skins, denude themselves of much clothing at their work. The portions of such a factory which are seen by the passers-by, are indeed nothing but these huge drying lofts, whose sides are composed of louvre boards, and the floors often of open lathwork.

As we pass from room to room we are surprised to observe the speed with which lads and young women cut out and run through machines, something like sewing machines, the hat-leathers and other articles, which are to be seen in large packages of many thousands. Calf-leather for bookbinding in all colours, with a beautiful smoothness that feels to the touch like satin, leather for furniture, and leather for gloves, we see in the very rarest and finest qualities, in such quantities as awakens quite a new conception of the place of Leather in the world's requirements, seeing that this is but one of a multitude of similar establishments.

What are called "calf-kids" are mostly made from young calfskins which come in large numbers from various places, their nationality being easily judged by their colour and markings of hair. Those from Ireland are chiefly brown, while those from Holland are nearly black, streaked with white, resembling Paul Potter's well-known bull at The Hague. These skins on being taken from the animal are salted and sent over in bundles. The first stages of the progress through which they pass generally resemble

those described in the dealing with the sheepskins and hides; only that in the "fleshing" of these skins Messrs East and Son have recently brought into use a machine which does its work in a remarkably expeditious manner. This machine has a revolving cylinder fitted with knives placed obliquely; the skin is passed over a bench in front, and at the will of the operator is brought under these knives. By its aid, one man or a lad will admirably flesh as many as thirty dozen skins a day, while the workmen could not get through more than eight dozen. In the later stages the treatment is very nice, and dependent on the exactest adjustment of proportions, fine flour, yolks of eggs being largely used, together with alum, oil and salt. At Messrs East and Son's large works, no less than ten sacks of flour and the yolks of 2000 eggs are on an average used weekly. To attain the exact proportions of the ingredients and also to maintain a certain temperature was a difficult task. Now the dressing was too hot, now too cold; at one time the oil was not quite so clean and fine as it ought to be, at another, the skins were allowed to remain a few minutes too long in the drum. But practical knowledge, combined with resolute will, enabled Messrs East to gain the victory; and now from their premises there is a steady turn out of the finest calf-kids. The drying, the dyeing, the grounding, and all the other parts of the process require the greatest care; and the final dressing (after the skins have been blacked, by what looked like a mixture of size and tallow, but may be very different), is followed by ironing exactly in the same way as a

laundress irons a pocket-handkerchief. The surface is now smooth and shiny; the skin is soft and equal through

Ironing.

every part; and its next metamorphosis is into the glove or the kid boot, with which everyone is familiar.

It is only within a comparatively recent period that the French have worked the black calfskin. In spite of their signal ingenuity in dealing with kid, they failed for a long time with the calf; and are indebted to Irishmen who conveyed the secret to France, and surrendered it at last for a good price. The French soon learned the practice and improved on it, and now many a calfskin passes for pure kid. In blacking these skins great skill is required, as only a certain amount of the blacking material must be laid on at a time, else it will go through the skin and spoil

all. The finishing, too, demands nicety. Only the best glue must be selected—usually that prepared from the refuse of glove-leather, especially of young goatskins—showing another curious and valuable application of what was once largely waste. This is mixed with well-solved soap and a little gelatine. The glue is laid on with a fine sponge, very evenly, and left to dry, when, after being wiped with a moist cloth, the skin is finished.

French "glazed kid" is made by putting the skins into what is called a "white bath" after they have been drenched. The "white bath" is a solution of alum and salt, and, after a short time, to this is added a paste consisting of heated white flour and the yolks of eggs.

V.—Special Processes for other Forms of Leather.

A word or two may not unfittingly be added about the special processes used in producing other forms of Leather, though we have been principally concerned with the sheepskins. Morocco Leather, made originally from goatskins, is nowadays frequently made from sheepskins, tanned in sumach, dyed in the ordinary way, having been previously immersed in a solution of sulphuric acid; and the grain or stamping upon it is done either by hand or by machinery, similar to that which we have already described for the purpose of diceing or graining. Very fine small skins for gloves are often prepared by immersion in a solution of alum and salt instead of tannin, flour and the yolk of eggs being afterwards applied to soften and whiten. Buff Leather, not now quite so much in request as in

former days, was at first made from the skin of an animal called the *buffe,* or urus, which was then common in Western Europe. When new, the Leather was always a tawny yellow, and the skins gave the name to the colour. Cordovan Leather was first made at Cordova, in Spain, from hides dressed to be used with the grain-side outwards. It was from this leather that the title of cordwainer came. Russia Leather is tanned in an infusion of willow or birch-bark, and derives its peculiar and long-enduring odour, so efficacious in keeping out worms, from the birch oil with which it is dressed. Larch bark is also used for some of the fine Leather, as it is said to give an aromatic odour something resembling birch bark; and others are treated with solutions of the wood-shavings of cedar with the same end. Levant Leather is first "struck out" in warm water on a mahogany table, "blacked" with logwood and iron liquor, then polished by revolving rollers, and "grained up," by the workman with a "corking board" on a table. The grain is set into the Leather in a hot stove, and after this it is oiled with cod oil. In finishing japanned Leather the japanning mixture is worked by the hand alone. This mixture consists simply of linseed oil and Prussian blue, the last coat being of linseed oil and lamp black, put evenly over the surface as it lies spread out on a table. No machine has, as yet, been made to supersede the hand in this part of the work. In the blacking of skins a mixture of ox-blood and acetate of iron is now very often used.

In manufacturing japanned or enamelled Leather, the

varnish used to be put in a warm state upon the flesh side of the Leather, which had been very carefully freed from fat, perfectly smoothed, and dyed with lampblack and turpentine, and then dried partly in warmed rooms, kept carefully free from dust, and partly by direct heat of the sun in the open air. It was found, however, that the Leather grounded with lampblack always gave off in the sunlight a kind of reddish brown tone. It is to avoid this that the Leather, in most cases, is now grounded with a solution of aniline blue soluble in alcohol, the varnish, as we have said, being then put on as usual.

Buckskins and goatskins at Astracan are rubbed with honey and allowed to lie in it for two or three days; sheepskins for morocco Leather are saturated at Fez and Tetuan with ripe fresh figs; pomegranate bark being the agent that imparts the fine yellow tint in dyeing.

As a curiosity, a few particulars may be given about shagreen; shagreen is horse, occasionally, and occasionally ass. It is almost peculiar to Astracan, where Tartar Armenians prepare it. They cut a small semicircular piece of the horse's or the ass's hide from the back, just above the tail, and they cut this small semicircular piece only. They take it and scrape it with some of the usual methods, and then they stretch it on a frame and lay it on a floor that is strewn with smooth hard black seeds of the ala lenta and goose-foot (chenopodium). It is these seeds that give the skin the mottled appearance for which it is admired; and they are trodden hard into it, after a felt has been laid on it, to insure that the tread shall be so well diffused, that

it shall not cause a split or crack. The beautiful malachitian colour of shagreens comes from a bath of sal ammoniac and a strewing of copper filings; the blue tint is given by indigo; the black by galls and vitriol. In either case, the final dressing is of oil or suet; and every dressing is hard and tight, and strained rigidly. Thus it is no wonder that a metallic surface is imitated, and that the familiar horse or ass gets no recognition beneath so much bewilderment.

Among the curious products with a claim to novelty which were shown at Paris in 1878, was the "Transparent Leather" made by M. P. Chenon, of Paris. This Leather is coloured a reddish colour, and is transparent, and would give the impression of dyed raw hide if it were not soft and perfectly flexible. It possesses the property of bending without the tendency of returning to its original position, as Leather would; on stretching a strap a slight elasticity is noticeable. These properties render the new Leather especially useful for sewing straps; the strap lying close to the Leather, a perfect seam may be made. It is nothing but raw hide, to which the properties of softness and flexibility have been imparted by impregnating with a certain quantity of glycerine; some alum being added. A piece of cow-hide is limed, then fleshed and pared, rinsed, and scraped, next stretched in a frame, as is done with japanned Leather and parchment, and finally, perfectly dried. After drying, it is put into a mixture of glycerine and water, to which have been added small quantities of alum and dyeing matter.

The settlers of Australia are naturally very anxious that kangaroo Leather should have a share of attention in England. They have tanned and sent over several bundles of skins; and certainly if the bulk of kangaroo Leather is like the samples we have seen, it is worthy of welcome—the Leather being light, tough, and supple in such a degree as to be almost superior to any other kind. Considering that we need to import so many skins, and that those of the kangaroo can be got cheaply, we may yet have reason to bless the marsupials; though we fear an extensive demand would soon do much to kill off that very interesting link between the animals of later times and those of a long past period.

One of the most peculiar products of the tanner recently has been a considerable quantity of crocodile Leather. It is asserted that this Leather is bullet-proof, but this, we need hardly say, is putting too fine a point upon it! Assuming, however, that such was the case, it forms almost the only advantage crocodile Leather possesses, while the disadvantages are numerous, not the least being its scaly, uneven surface, which is apt to form a refuge for dust and dirt. From this we should think it very unlikely that crocodile Leather will ever find extensive favor. There are, however, several imitations in the field. These are made of ordinary Leather, strongly embossed, and sold at prices almost as high as that of the genuine article, which we need not say is excessive. And those who know well have informed us that the bulk sold as crocodile was pure imitation; so let no man boast himself

too highly of his crocodile travelling-bag. Nothing is gained by the substitution of a rough and unequal for a smooth surface, all other conditions being alike.

VI.—Imitations of Leather.

The mention of "imitation crocodile" leads us to say that enterprising persons have at various periods entered very vigorously on the attempt to find a substitute for Leather; but not with much success. The history of their experiences is interesting and curious. Not a few of the more recent productions in this direction, the result of large experience based on extensive chemical knowledge, have been remarkably good, so far as mere appearance goes; but they have generally only "kept the word of promise to the eye to break it to the hope." We shall not speak of the more commonplace oil-cloths, varnished by peculiar processes, used chiefly for cheap furniture covering, for it is hardly an imitation but merely a substitute; we shall deal only with one or two of the more scientific and pretentious. The first is American and is thus described:—

"The materials used are cotton, or cotton waste or dust, cocoa-nut fibre, and other textile by-products, and *fucus crispus*, a marine moss abundant on the New England coast. The waste is first carded into sheets of wadding of uniform thickness, and then laid on polished zinc, kept at a high temperature, and treated with a decoction of the fucus till thoroughly saturated. The sheets quickly become dry, and in a few minutes may be lifted and

passed between hot polished rolls adjusted to give any thickness to the finished Leather. These rolls are under heavy pressure, and completely felt the materials into strong, tenacious, and flexible sheets. The sheets are next coated with boiled linseed oil, and dried in the open air or in a dry room. When dry they are coated with vegetable wax, and run through hot fluted rolls, and are finished by a final passage between polished rolls. The Leather may then be bronzed, silvered, varnished, or otherwise treated like ordinary Leather. To produce white Leather, clean cotton is used, and all the whitest pieces of the dried moss, and bleached linseed oil."

There is one imitation of Leather, which is an exact realisation in industry of the fable of Chronos eating up his own children and reproducing them. This is the system of making old or waste Leather the basis of new manufactured Leather. The tannin may either be drawn from the old Leather or left in it; but is generally the former, and in this case several processes are brought into play. The tannin is generally preserved by being hermetically sealed up from contact with air, and in combination with other acids is used again in re-tanning the matter from which it was taken. The chips are reduced to a pulp, and while cold are treated with sulphurous acid, either in the form of dry gas passed through it or in the form of aqueous sulphuric acid. The object of this treatment before pressing into sheets is to produce greater cohesiveness of body. The pulp is then subjected to moderate pressure to get rid of superfluous moisture.

The firmer pulp thus prepared is then formed into sheets by something of the same process as those employed in making hand-made paper, with vats, moulds and presses; or it may be pressed into blocks or forms for the soles and heels of shoes. It is then sized with pinite of alumina or boracic solution of casein, glycerate of lead. The sheets are then immersed in a solution of gutta percha, and rolled, either with hot rollers or pressed between hot plates by hydraulic or other pressure. They are then allowed to dry slowly, and are finally tanned or tawed like other Leather, a large proportion of willow bark or salicylic acid being found effective in this work.

A process which attains somewhat of the same end by different means is that of Mr Matthew Bird, of Limehouse. He takes a quantity of Leather, waste or scrap, and immerses it in water until it has become softened. He next removes the mass from the water, and subjects it to the action of a separating machine, by which action the Leather is converted into a fibrous mass. He then takes a quantity of spent tan, and subjects it to the like treatment until it also is reduced into a fibrous mass. The two fibrous substances thus obtained are mixed in certain proportions, with a certain quantity of steatite, or of talc, or of asbestos, or of fish glue, until the two fibrous and the other material or materials are converted into one intimately-mixed mass of uniform consistency.

In some cases, instead of using the waste Leather scrap, he reduces it to powder, or dissolves it, so as to be of a pasty consistency, and mixes it with the other materials.

The mixture in either way made is then run in between cylinders of wood, metal, or other material, so that by the pressure applied it is formed into sheets, or it may be pressed in moulds into the form desired. The sheets or moulded articles are then dried by stove heat or other heat.

The sheets or moulded articles are then, if it be desired to render them capable of withstanding or resisting the action of water and of oil, subjected to treatment with dissolved paraffin and stearic pitch, or other chemicals or minerals having similar properties, by either coating them or painting them with the mixture, or immersing them in a bath of it. This mixture may also be applied to the treatment of solid Leather. The proportions are seventy-five parts of paraffin to twenty-five parts of stearic pitch.

The third is French in origin, and for it a patent was granted in England in the beginning of the year 1880. It claims to be wholly different from all former fabrications professing to be substitutes for Leather—"norrogats de cuir," varnished cloths, &c. The process is thus described:—

"Taking for a model the veritable skin from which the tanner by his labour forms the Leather, this skin is constituted of its natural fibres interlaced, forming with the gelatinous matter an entirety known as hide, which after having been submitted to the contact of tanning substances passes to the state of Leather more or less permeable and more or less soft, according to the treatment to which it is

subjected. His aim is to manufacture a product resembling natural Leather in all respects, and as much as possible capable of being sold at a "good price," and fulfilling the same conditions as Leather. To this effect he establishes by means of a carding machine a nappe or felt of any cellulose fibre, whether linen, cotton, or hemp, of thickness variable at pleasure. The fibres of this felt are designed to replace those that exist in the natural Leather, in giving to his product a consistence equal to that of natural Leather without the necessity of having recourse either to a spun material or cloth, as that which is actually used for products known as Leather-cloth, &c. The felt obtained by the carding machine has a very uniform thickness, which is not the case with the natural Leather.

"Theory says that, while the raw hide does not contain glue, although the latter is extracted by cooking, the fundamental principle of the glue does exist in it. Since, then, the fundamental principle of the glue does exist in the raw hide, and the glue which he brings in contact with the tanning, in the same way that the raw hide is brought in contact with it, produces the same effects of impermeability and of tenacity obtained by the tanning upon the raw hide, there results a very close similarity between natural raw hide and his felt of cellulose saturated with animal or other glue, liquified with water, and submitted to the action of tanning.

"In comparing the two products, the raw hide and his, they possess the same character; they become hard and stiff in drying; neither the one nor the other possesses the

character of Leather; both brought into contact with water soften as completely and in as little time.

"To remedy this, and to cause this raw skin to enter into the category of Leather, the tanner submits this raw hide to the contact of a tanning agent to obtain impermeability, and by means of grease, of which the use is well known, he gives it pliability according to the kind of Leather that he wishes to make. In submitting his product to the same treatment it acquires the same character.

"In making the comparison between the character of the raw skin and his felt formed of cellulose and a glue of some kind, one finds that they are the same, since he can replace the fibres naturally existing in the raw skin by the fibre of the cellulose, and the matter containing the principle of glue known as corine by any other glue subject to be acted on by tanning. At this point he departs from the habitual of Leather by the tanner, instead of making, like him, the raw skin to undergo for more or less time the action of tanning, and afterwards that of grease, he forms a preparation, a liquid containing at the same time the gelatinous or gluey matters, the tannin, and the grease; with this mixture he soaks his nappe of cellulose in a manner to give it all the character of Leather, whether more or less soft or more or less hard, and at the same time more or less impermeable, always according to its destination. Thus, then, when his nappe has come from the carding machine, he makes it pass into the mixture composed, and from thence it passes between two cylinders heated by steam, which take off the superfluous matter. This Leather

stove-dried or air-dried, can then be considered as raw material possessing the character of imitation natural Leather, capable of being dressed or fashioned like the different kinds of natural Leather. In this situation it enters into rivalry with natural Leathers, compared with which it possesses the same tenacity, the same soft character, and it can admit of all colours and impressions. Avoiding in his fabrication all spun material or cloth, and being able to manufacture eight hundred to a thousand metres a day, he obtains a product that can be produced at a very cheap rate.

"It can be applied to shoes, upholstery, hat-linings, and other uses to which Leather is applied."

But to this, as to many former claims of the same kind, it must be said that "Time will try." If, however, scientific skill can come so close to producing diamonds, there should be no fear that, finally, "good Leather may be made."

Thus we have seen that the animals whose skins fall into the hands of the tanner are very varied indeed, and that the one skin not seldom is so prepared as to pass for the other; and is so well received as a substitute that, though everybody knows the secret, no one refuses to call it by the accepted name.

Sheep, lambs, goats, kids, deer, bucks, oxen, bulls, and their tribe, buffaloes, porpoises, crocodiles, hogs, kangaroos, camels, horses, asses, rats, seals, weasels, and

dogs, are all represented at the tanner's yard; and many other animals of more exceptional character.

The modes of treatment are almost as varied as are the classes of animals that supply the skins; and it only remains to be added, with respect to the finer skins that, in all the processes of tanning and currying, great attention is necessarily paid to the *stretching* of the skin, so as to secure its utmost capacity, and the importance of this work increases, the nearer that we approach to the "finishing."

USES OF LEATHER.

So various are the uses to which Leather is applied, that we were perforce more and more inclined, as we proceeded in our inquiries, to endorse the maxim — "There is nothing like Leather." And this we say on the fullest knowledge that for some things it has passed into desuetude. We know better than to build big guns in that material, as did Charles the Second of Sweden, who had a battery of light artillery chiefly made of Leather—one gun of which is still, we believe, to be seen in the Copenhagen Royal Arsenal. "It consists of a smooth steel tube closed at the bottom, and tightly wound round up and down spirally with tough Leather bands about two inches in width. This accumulation of bands is covered with a piece of Leather, which, through use and age, has become black and shiny, and the gun looks at a distance like an old-fashioned bronze six-pounder." We know also that the human skin itself has been utilised, and that it was the custom to tan the skins of notorious criminals, who, after execution, had passed to the hands of the anatomists.

There is at the present day in the library of the Bristol Royal Infirmary a curious book, which contains the account of the trial and execution of a man for murder, and is bound in the skin of the culprit. We also know that amongst the ancients Leather money was in common use, and would, if specially got up for the purpose, make a very good substitute for the precious metals now in circulation. Nay, we have it on the best of testimony, that Herr Rosenheim made him a Leather man, who could do almost everything but digest and speak.

Even with the sheepskin to which at present we limit ourselves, we shall have enough to do to indicate generally a few of its more important destinations. It is made up into shoes and slippers of the lighter sorts; it appears under various names in several kinds of gloves; it is highly approved as gaiters and leggings; and it passes into many shapes as pretty bags and trifles, not to speak of finer straps and buckles and such-like fittings. Nay, as we shall see, it is indispensable in war, and has also a good deal to do with the most precious of our possessions; successfully holding its own against paper in one of the higher walks of life; which is surely saying a good deal, seeing that paper—that modern Proteus—is nowadays so influential and aggrandising. And first we shall speak of the sheepskin in the process of being converted into gloves.

It has been said by a French writer that the degree of civilisation attained by any people might be told by the gloves they wear. Savages, of course, wear no gloves, and

what we regard as elegance in the hand, like the subtler shades of colour, is wholly unregarded by them. We do not know whether the Frenchman would regard it as a decadence that gloves are nowadays more frequently held to prosaic wear than used as gages to summon a rival to arms; but, assuredly, the great progress made in the manufacture would amply bear out his idea; and a short account of visits paid to one or two factories like that of Messrs Dent, Allcroft and Co. at Worcester, will amply attest this.

The sheepskins, having undergone the process of dyeing or staining referred to in our former chapter, are dried and packed up, and reach the glove manufactory in a somewhat hard and stiffened condition. After the skins have been what is called *moistened, i.e.*, buried for some hours in a damp, bran-like mixture, the first process is directed to stretching the leather and softening it, and is called *staking*. In a large room we see more than a dozen men engaged in vigorous efforts, drawing the skins with considerable force over a kind of blunt-edged, round-topped, knife-like piece of metal, supported on a stand, and at the height best suited to give the workmen the pressure he desires; each skin is drawn over this *staking* knife perhaps twenty times, and every part of the skin must be submitted to it. When we handle the skin after this operation it has certainly undergone such a change as could hardly be believed of so simple an application. It is now smooth, soft, and flexible, and the colour is brought fully out.

A very singular instrument is seen in use in the next chamber to which we are introduced. It looks in shape something like a *quoit,* though a moment suffices to suggest that it must be hollow and thin, since the workman with apparent ease plies it on the skin fixed into a wooden frame before him. He is engaged in *paring*—a most

Paring Glove-Leather.

important part of the glove industry. His knife is thus shaped because it has been found that, after due training, he can control it better than a knife of any other form. The handle is fixed on the inside opening, and the outside edge is kept singularly fine by frequent touches of a very thin steel wire. His thumb is armed with a Leather cap, lest the knife should run into it, as it is inevitable that he should bring the edge very close to the point where he holds the skin between his thumb and finger. By this process all the loose and rough texture is removed, and the

skin completely equalised throughout. The use of this knife requires no little skill. When the skin has passed through this room, it goes on for *sorting*. In the sorting-room the skins in each parcel are arranged according to capacity—that is, the number of pieces to be got out of each, and the sizes of the gloves into which they are to be formed, are indicated. Then they pass into the *cutting-out* room.

The cutting-out of the finer kinds of gloves is anything but a mechanical piece of work, as might perhaps be supposed. Were the Leather stiff, a mere mould or knife might be set down upon it, and the shaping thus accomplished. But the finer, the more yielding and flexible the Leather, the more skill is needed in the cutting. The getting of the stretch of the Leather is the great point. By this it is meant that the cutter must be able to judge from the flexibility of the Leather how much to allow in the length for the breadth of the hand. For this purpose he pulls the Leather to its extreme stretch from side to side, and measures it, and then stretches it from head to tail; having made the necessary allowances, he lays on a stiff square paper model, cuts first the two sides in one piece, then the thumb piece, after that six forchettes for going between the fingers, and various other smaller pieces (the most minute of these being carefully stretched and manipulated as we have described). He has thus got one glove cut out. The fellow follows; and before long he has a bundle ready. The bundle is conveyed to the "punching" or stamping room, where are a number of

presses at which lads and boys are at work. Their first business is to lay four of the "front and back" pieces opened out on a "knife," or cutter, presenting sharp edges exactly in the form of a glove. Having spread a few layers of paper over them, the press is brought down, and in an instant you see the two sides of two pairs of gloves completely cut. The thumb-pieces are next cut at a press in precisely the same way; the various minute pieces are attached to each pair; and then you have your gloves ready for sewing.

This is a department of the work which presents some curious statistics. The mere division of labour in the sewing of gloves nowadays is noticeable. Sometimes a single pair passes through as many as four hands in the sewing. One person does the thumbs and fingers, another does the backs, a third does the "topping" or wrist-binding, and a fourth puts on the buttons and works the button-holes. Down at Worcester, Messrs Dent and Co. have reduced this part of the work to great system. They have a staff of men who go on fixed days to the villages around, taking gloves with them to the workers and bringing back the sewed gloves. These men also see any persons wishing to be employed, judge their capacities, and attach them to the proper "hands" to be taught. Glove-sewing is mostly done by the aid of a "clam" stand, something like a vice, which is held between the feet and knees. The glove is slipped into the "clam," the cut edges being almost level with the top surface, which is of brass, and is really a series of fine teeth. The needle—a

very short one—is passed through between these teeth, the worker being thus guided to regular stitches. It is somewhat singular to learn that at Worcester the women in the villages are mostly kept to the thumbs and fingers, while the backs and "topping" are, for the most part, done by persons in the city itself; and, as can very easily be understood, the superintendence of these people and their work demands great care and prudence. By means of this and the skill and enterprise we have seen brought to bear, we have the famous "dogskin" glove, which is simply a fine sheepskin.

Some statistics of glove-making may not be unwelcome here:—

It is estimated that 12,000,000 pairs of gloves are annually made in the United Kingdom, besides which 4,000,000 pairs are imported annually. There is an old proverb that a good glove should be of Spanish Leather, cut in France, and sewn in England. If we take the average value of the gloves made in this country at 2s. a pair, that gives £1,200,000. Although we are well supplied with the skins of animals at home, having plenty of sheep and goats, nevertheless large quantities are imported for glove-making. In 1855, the following were the proportions:—

	Number	Value.
Goat	503,918	£44,071
Kid	695,859	100,012
Lamb.........	828,031	38,682
Sheep.........	977,970	51,211
	3,005,778	£233,976

Beaver gloves were formerly made at Worcester and Hereford of Leather dressed with oil. At Limerick they are notable for making what are called chicken gloves, from the skins of very young calves, and packing each pair inside a walnut shell, fastened with a little silk riband, which are retailed at 5s. a pair, thus énvelopped.

These figures, which indicate that the kid-glove industry outstrips in value any other department in this country, suggests the propriety of our here digressing for a moment to say a few words about the *earlier* stages of the preparation of the kids, as seen in such factories as that of Messrs Dent, Allcroft and Co., the later ones so far resembling those in the case of the dogskins that we need not detail them. The bulk of the kidskins come from France, having already passed through some of the preliminary processes of manufacture. On their arrival they are *swilled,* that is, washed and trodden in pure water; they are next *egged,* which means that they are beaten, for about an hour, under a series of wooden shafts that move up and down with some force in a great tub among egg-liquor, till they are impregnated by it and come out of a yellow tinge. Those which are meant to be dyed in delicate colours are again put in tubs, and in some cases the dye is trodden into them by men. These are called *plonges,* the colour appearing on both sides. The kids meant to be black, on the other hand, are spread out on a table with a drawer-like top, and are prepared for the colour, which is laid on with a brush, by a chemical mixture. The greatest care and attention, we need hardly say, require to be paid to them in the drying.

They are then submitted either to a French process called *dolling,* that is, they are skilfully scraped to an equal thickness by a very fine-edged, broad, and chisel-shaped knife, worked on the inside of the skin, of course, on a smooth marble slab; or they are treated by the English round knife, as we have described in the case of the "dogskins." A special preparation of gum is then rubbed on the skins to bring out a true black instead of the blue-black they at first appear, and they are then ready for the *sorting* and *cutting-out,* as we have before described.

It scarcely needs to be said that for each size there are separate moulds or knives, which are very carefully kept on shelves arranged for the purpose. It is a responsible part of a man's work to keep all these knives sharp and in proper order; and for this purpose they are so made as to be easily unscrewed and taken to pieces.

The sewing-machine has recently been adapted to the making of gloves of the stronger kinds. Many of the dogskins are now sewed by it; but the finer kids are so very soft that a straight seam cannot be kept, the edge generally running into puckerings under the needle. It is probable, indeed, that for a very long time to come the hand will remain unsuperseded by the machine for the very finest glove-work.

Of course, all the gloves on their return to the warehouse are subjected to a searching scrutiny. Anything that is found deficient in the sewing must be rectified, while any fault that may have escaped notice hitherto in the Leather itself, determines the descent of the gloves into the category

of an inferior quality. At Worcester, Messrs Dent and Co. have a small staff of long-experienced men for this work; and we need not say that the store-rooms are large and well-kept, or that it is a fine sight to see the room for giving out and taking in the work, with its piles and baskets, and gloves in bundles of all kinds and colours in the various stages of progress. The arrangement of the finer classes of gloves into packets of half-a-dozen is the work of girls, who handle the most delicate tints with perfect impunity.

During recent years things have in many respects greatly altered with the soldier, and mostly for the better; but all the changes have not lessened his allegiance to Leather. It may be justly said that he could not live or move without it. It is true that the stiff Leather stock that for so long a time cramped his free movement is now discarded; that cork is rapidly taking the place of fur in his head-gear; and that under no possible development of invention can we conceive of a return to Leather artillery; but still buff, and bull-hide, and japanned Leather, and sheepskin are so essential to his equipment that we should entirely fail in our duty did we omit reference to the part it plays in a soldier's outfit. If we visit an establishment like that of Messrs Alexander Ross and Co., army contracters, in Bermondsey, we shall soon convince ourselves of this. (By the way, a great lull in that industry often suddenly gives place to as marked an activity; for a large army contractor's workshop is like the pulse of the nations, telling how the war feeling rises or falls, or even the

subtler changes of national temper—suspicion, jealousy, and the determination to be prepared. Free-trade is observed in this department, and English contractors may be producing outfits for a foreign power.) We cannot now do more than follow up some kinds of sheepskin; but it must not on that account be supposed that we are not fully alive to the claims of the heavier Leathers in a military point of view. The soldier sits on a Leather saddle, he uses a Leather bucket, his belts and knapsack are of Leather, and so is the scabbard of his

Rivetting Leather Buckets for the Soldiers.

sword or the rest of his carbine; and of Leather are the bags he carries his stable and other tools and often even

his rations in. But here, at Messrs Ross and Co.'s, we must resolutely abide by our sheepskin, else this chapter would run to inordinate length.

First we see at a table a man engaged in work very similar to what we saw at Worcester. He takes a white skin, stretches it first one way, then the other, and clearly enough proceeds to cut gloves out of it. Having cut the "backs and fronts," he sets together all the little pieces, just as we had already seen, in preparation for the mould at the press; and when we ask him what kind of Leather he is cutting, he tells us that it is "mock-buckskin" for soldiers' gloves. But a very little questioning brings out the fact that this "mock-buckskin" is simply sheepskin which has been wrought in some degree like chamois Leather, in a peculiar preparation of egg and cod oil, and afterwards whitened by a process peculiar to itself. These gloves are sent down to Woodstock—that quaint, ancient Oxfordshire town where is still to be seen something of old-world quiet, undisturbed by railway bustle—and there the gloves, consigned to a master glover, are given out to be sewn by the women of the district, and by-and-by reappear in London, to be seen in bundles at the great army stores in Pimlico, and later on the hands of our heroic defenders.

Another piece of sheepskin, which the mounted soldier cannot well do without, is the *shabraque*. It is prepared in the same way as fur, and forms the covering over the saddle, adding not a little to the fine appearance of the cavalry. The Zouave Leather leggings which are to be

seen on some of the volunteers who still wear grey, as well as on some of the regiments of the line, are of tanned sheepskin; so are the basils and stable-bags for carrying tools and brushes, with which we can hardly presume our readers to be quite so familiar.

From the men of war to the men of law is a long step, and yet not wholly unjustified. Both depend a good deal on sheepskin. If the cavalryman sits upon it, and the foot-soldier often carries his rations in it, the lawyer almost lives by it in the shape of parchment, in which lies at least his security. The skin, generally the *corium* or flesh side of the split sheepskin, is prepared for parchment, after having been submitted to the action of lime, by tightly stretching it upon a wooden frame, and carefully scraping and paring it, while pulverised chalk is rubbed on with a pumice-stone. After having been thus reduced to about half its original thickness, it is smoothed, and dried at gradually advancing temperatures, for use. Parchments are also made out of goatskins; but the sheepskin is more generally used. Vellum, again, is made by a similar process from the skins of young calves. Mr Warren De la Rue has produced a very good imitation of parchment out of common paper. A sheet of blotting or unsized paper is dipped into oil of vitriol and water, which causes it to acquire some of the properties of parchment, and it has been used for some of the purposes of parchment. But its durability time alone can test; and it is not likely to be very generally adopted for a time. Parchment is likely, if anything can, to enjoy a long prescription.

Nor are the uses of the sheepskin even yet exhausted. Not to speak of the various kinds of beautiful furs for rugs and other purposes, Northampton and Leicester turn out thousands of pairs of light sheepskin shoes and slippers week by week; and ere long, by the aid of "Silver's Patent," which can securely *screw* on thin soles as well as thick ones, we may hope that the price of shoes may be somewhat reduced. Hedging gloves, gardening gloves, and sportsmen's gaiters are mostly made of tanned sheepskin; and, as we have seen, the fine white Leathers that line our hats are cut out of dressed "skivers." Nor should we forget bookbinding, in which Leather plays so conspicuous a part that it is often more in the mind of the possessor than the literary contents. Burns well satirised one gentleman of his day for the inordinate stress he laid on the Leather, writing:

> "Through and through the inspired leaves,
> Ye maggots, make your windings;
> But, Oh! respect his lordship's taste,
> And spare his bonny bindings."

When we reflect that to the sheep we owe thick tanned soldiers' bags as well as the finest parchment, "mock buckskin" gloves as well as tanned leggings for our soldiers, shoes for our children and "dogskin gloves" for our own use, we will perhaps be the more ready to acknowledge the bountifulness of Providence and the wonders of industrial appliance.

WOOL.

A CLEVER man once argued that cork-trees grew to supply stoppers for ginger-beer bottles. That was his way of hinting that too much might be made of the argument from design. In spite of the warning thus conveyed, we must, in the outset, mention a very curious fact or two about Wool, that may be regarded as strengthening the argument from design or not, as the reader chooses. Wool is simply a kind of modified hair, depending on the very same conditions of the skin, into which we cannot now enter. But hair—especially human hair—and Wool differ very much in one respect. Hair, when seen under the microscope, gives a succession of markings, more or less regular, running across it, indicating that it is composed of a series of cells very closely pressed together; but Wool shows these markings so much more defined that they present a serrated outside surface, resulting from the inequalities where the cells join together. It is because human hair does not have these serrations that it cannot be felted, and that it can be woven only

with great difficulty, and would not make very warm garments even if it were. In preparation for some of the worsteds, indeed, one of the processes in combing Wool aims at reducing the degree of serration, so as to obtain more smoothness and softness in the fabric. It may be mentioned, too, that one of the main reasons why such staples as mohair and alpaca so imperatively need to be mixed with other substances in being worked arises mainly from the faintness of the serration. Sir Titus Salt's wonderful foresight and skill were seen as much in his clear discernment of the requisite qualities in the mixing staples, as in the conviction of the availability of alpaca itself to produce a glossy and beautiful cloth. These microscopic inequalities in the Wool are thus what give it its great value as a woven commodity—hair having little cohesion when woven together. Though the Wool-spinner may not have the fact in mind when he purchases his raw material, it is really the number of these serrations which determines qualities. The finer the Wool the greater the number of serrations. The best Saxony Wool, we learn, contains some 2700 of these serrations in a single inch: merino Wool only about 2400; our own Southdown about 2100; while the coarser sorts, as found on some of the Leicester sheep, does not present more than 1850. It needs to be borne in mind, however, that several qualities of Wool are got off one sheep, and this it is which gives rise to the occupations of Wool-sorting or Wool-stapling —a process which, in the rough, we saw begun at the fell-monger's, and we now propose to take up the Wool as we

found it there in big roughly-assorted heaps, and to follow it further in its destination.

But when we are introduced into a large Wool factory like that of the Messrs. Priestman and Son of Bradford, where all the processes, from the sorting to the weaving, are carried on, and find ourselves very quickly transported by a lift to the top of the building, some five or six stories high, and are ushered into a large hall, we find that our Wools of English produce form but a portion of the raw material about to be submitted to the various processes here. Australia, of course, is now the main source of supply. About two-thirds of all the Wool imported into Great Britain is from Australia, where, on the immense farms, sheep are raised for their Wool, and not for their mutton, which is there certainly at a discount. In Great Britain there is on the average one sheep for every individual in the population, whereas in Australia there are twenty-two sheep for every inhabitant. The grasses of Australia, though less soft and succulent than those of Great Britain, which owe so much to the excess of moisture and the rainfall, of which we are so apt to complain, are very favourable to certain breeds of sheep, which are the exceptions in the animal creation for capability to subsist and thrive without much water. Merino Wool comes from Spain, and is due to a very fine breed of sheep: a small portion of fine Wool nowadays also comes from Holland. The fact that Wools now come in such quantities from distant places implies very tight packing in large bales. In order to prepare this Wool for the sorters

or staplers, it is put into a press heated by steam, the action of which on the natural grease of the Wool speedily transforms the hard, stiff heap into a series of soft layers, which, when thrown on the table in front of the stapler, show themselves as whole fleeces. The business of the stapler is carefully to pick out and to arrange the various parts of the fleece according to its quality, which he does by picking it apart and throwing the different qualities into different divisions before him. It is astonishing how dexterous the staplers become in this work, as may be guessed when we mention that five or six classes of Wool are found on each animal, and that a good stapler will sort a fleece in a quarter-of-an-hour or so. The main classes of Wool are super, Southdown, fine combe, kindly combe, and Dutch, for the finer kinds; and livery Wool, grey Wool, pipe tegg and picked tegg, for the coarser. The former are used for blankets, flannels, fine cloths, tweeds, and shawls; the latter for such common cloths as are used for army, navy, or prison wear. The designations, though originally derived from obtaining local distributions, are nowadays very unreliable in that regard; for some nations have improved their breed of sheep with far greater skill, and have made much more progress than others. Dutch Wool, for example, is now not seldom super or kindly combe, and Spanish Wool may take rank as Dutch—a reversion at which probably the Hidalgo would not feel greatly flattered.

The next process through which the Wool passes is that of *washing* or scouring, and for this purpose it finds

its way to the lower portion of the building. To remove the dirt and the oily substances, it is thrown into troughs of soap and water and beaten from half-an-hour to an hour; and in being transferred from one trough to the other it is put through rollers something like Messrs Bradford and Co.'s wringing machines. When it has thus been thoroughly scoured, it is thrown into a large enclosed space by a fan at the end of the last set of rollers, the purpose of which is to open out the Wool and throw it loosely down. It is now beautifully white, and delicate to the touch. We are speaking only of the finer Wools manufactured at such works as those of Messrs Priestman's.

Next comes the *carding*. The Wool is spread out on a kind of flat table, where it is gradually drawn in and run through a series of cylinders with wire teething, which has the effect of opening and breaking it up, and throwing out the very short Wool and any dirt that may have remained in it. The wonderful power of machinery in saving labour could hardly be more impressively seen than here, when one thinks of the old-fashioned way in which Wool was carded at a time not so very remote. After having been submitted to what is called *doubling*, which simply means the uniting of ends so as to form a soft and continuous stream, the Wool passes on to the *backwash*. It is once again run through soap and water to free it from any oil or dust that may have attached to it in the former processes; and after having been preseed by passing through rollers, and so far dried, the fibre is beautifully

straightened by the ingenious contrivance of needle-like teeth fixed in a regular band, which rise and fall, and thus effectually penetrate the Wool as it passes. It is then deposited in what are called *preparing* boxes—that is, it is placed in regular strata in deep tin vessels, out of which again it is run by a machine into balls ready for the *combing.* Messrs Priestman and Co. have two forms of combing-machines in their establishment, and both are very perfect and beautiful in action. The first is Noble's combing-machine, and the other is called the Orleans. Noble's machine, in its earlier form, was for a time superseded by the Orleans; but under later improvements it has almost regained its pre-eminence. The principle of the Noble is a revolving teethed wheel, which is fed with the Wool at one side, and in the course of the revolution it is combed by two arms or hands which constantly move back and forward alternately, passing a comb through the Wool as it revolves, and drawing out what is short and unequal. The Orleans is more complex and less easy to describe in untechnical terms, but it also adopts the teethed revolving wheel. The Wool which is deposited after each revolution from the revolvers is called the *top,* or fine Wool, and that which has been combed out is called *noil,* or short Wool, which is of course once or twice recombed. The Orleans, we are told, makes as clean a *top* as the Noble, but in some respects is a more difficult engine to manage and to keep in order. The next process is called *drawing.* The Wool, of course, comes from the combing-machine in a full untwisted stream almost as thick as

two fingers: the drawing is the process by which it is reduced to thread thickness. This is followed by *roving,* whereby this Wool thread is run on to smaller bobbins to suit the spinning machines.

On entering the spinning-room we are somewhat surprised at the number of quite young boys and girls who are there; and as we observe the steady and beautiful movement of the machines, we are somewhat at a loss to guess what work they can be wanted for. The little girls who do the sweeping are very assiduous, flitting about in all corners, as they much need, for ceaseless clouds of woolly particles are thrown off, which but for them would soon cover the machinery and the floor. There are from one hundred and sixty to two hundred bobbins on each of the machines, which are ranged along the wall at each side, with a passage-way down the centre. Each girl has, strictly speaking, charge of what may be called two sides of different machines, the space between them running off from the centre passage forming the walk. And as we listen to the explanations given us, the use of this floating community soon becomes apparent. When the full bobbins are taken off the machine their place is at once supplied by empty ones from a line of pegs above; and this process is called "topping." The deftness with which this is accomplished is really astonishing. Immediately on the topping being done the pegs are refilled with empty bobbins against the next topping, and thus the small moving community of "toppers" is, after all, kept pretty well employed.

It was very cheering to see the interest which the Messrs Priestman have in their workpeople. Steam stoves for heating their dinners, dining-rooms and so on being admirably kept and managed.

The thought of the many kinds of machines which must be called into requisition before a single bit of wool is ready either for cloth or worsted, suffices to show how far we have moved away from that primitive state of society which has left in our language the very suggestive word "spinster." Women do not spin nowadays to qualify themselves for matronhood; but the word remains, like a fossil in a later strata, to impress on the mind the immense step made in the commoner industrial arts within a very short period of time.

It is impossible for us here to follow up the many processes of weaving and felting, but this we need the less regret, as they may be regarded as in their main features very familiar to most readers. One of the strangest things connected with the fine wŏollen cloth manufacture is the use of the common *teazle*, which as yet no invention has superseded, and which is to be seen growing in the fields in many districts in the west, yielding the farmer a very fair profit. After the cloth has been woven and scoured, to remove the oil which had been added to it in the spinning, it is *fulled*, a process which consists in beating it by heavy hammers for a considerable time; then it is scoured again, and then *teazled*. This is accomplished by means of a cylinder, which revolves upon the cloth with these teazles attached to it. By

this means all the loose woolly particles are raised up, so that they can be clean cut off, and thus make easily a very fine glossy finish. So effective is the teazle for its purpose that, though several inventions have been tried in its stead—among others a peculiar contrivance of wire fixed into a leather band—none of them have been found in the least to approach it. Nature here asserts her superiority to science. England produces only about one-third of the teazles needed for the cloth manufacture, the others being imported from the continent. The foreign teazles are said by the manufacturers to be by far the best.

As in most industries, a residuum of waste is found at various stages of the manufacture. Put the Wool through the carding machines as often as you will, some proportion, so short and broken as to be unavailable, will be thrown out; and again it is the same with the combing machine. This waste is not lost, however; and its destination suggests a glance at one industry which absorbs a great deal of it, and turns it to useful account. At Ossett and other places in Lancashire and Yorkshire, there are factories where large numbers of persons are employed in the making of Wool mattresses and beds. Some portion of the material used for this purpose, though not like the jewels in "Faust," from "the wrong side of the firmament," is yet directly received from the "Devil"—in other words, it is shoddy rags retortured in that ambiguously, but not quite inappropriately named machine. But to get the proper amount of softness and buoyancy it is

needful to mix this old material with a certain proportion of new, which is chiefly made up from this Wool waste scoured once more to free it from dirt and oil, and otherwise specially prepared for its purpose. These beds and mattresses find a ready market in all our large towns, and the numbers that are sold would, we are sure, astonish most readers, were exact statistics available, which, however, they are not. Suffice it to say, that many thousands within a small radius of Wakefield are engaged in this manufacture, and that the industry promises to grow.

We have now followed the Wool from its first stages to its last; and with this we close, fully aware that some points have been overlooked or too lightly passed over. But the most important and interesting facts have, we believe, been noted; and our purpose will have been served if any interest in industrial processes and industrial workers may have been excited in our readers. This is all the more to be desired at the present time when, owing to many causes, the industrial classes may be in special need of the indulgence and sympathy of their wealthier brethren.

WOOL-SORTERS' DISEASE.

Wool-sorting has a half-pastoral sound. In old days, doubtless, when the Wool was conveyed from comparatively short distances within the mother country, it was a healthy and innocuous occupation. But recently the whole aspect of things has been changed through the opening up of distant countries, and the introduction of wholly new staples which are prepared with a view to mixing with the old. The result of the way in which Wool is packed and of its long imprisonment in bales, has been the development of a new form of disease. It is an old maxim that trifles come to determine the most momentous matters, and the introduction of mohair, and some other foreign Wools, which seemed to be charged with such benefits for the public, has been found to affect the Wool-sorters very disastrously. "Wool-sorters' Disease" has been studied and defined, and takes its rank in the medical vocabulary as a new disease—a kind of blood-poisoning which speedily affects the lungs, often causing sudden death. Dr J. H. Bell, Surgeon to the Bradford Infirmary, whose position

has, alas! given him only too ample opportunities of diagnosis and observation, has lectured on the matter, and published his lecture in the *Lancet*. He says:

"The sorting of Wool is generally considered a healthy occupation, but the sorting of hairs, which are classed with Wools, such as alpaca and mohair, has long been known to be attended with considerable risk to life. During my inquiry into the causes of this, I have found sufficient reason to include with them as similarly dangerous, all Wools and hairs which are characterised by being dry, dusty, and more or less filthy from contamination with decomposing animal matter, and particularly if they contain "fallen fleeces" from diseased animals. Among these are all kinds of alpaca, goat's hair, camel's hair, low-class East Indian, Persian, and such-like Wools. The sorting of these is injurious to health; first, from the dust and fine short hairs which arise from them, exciting chronic diseases of the lungs, as bronchitis and consumption; second, from the amount and virulence of poison from decomposing animal matter which is liberated, producing a low form of pneumonia, which I may call septic pneumonia; third, from a specific blood-poison, derived from the fleeces of animals which have died from anthrax, producing the rapidly fatal disease called 'Wool-sorters' Disease.'

"I have tried to ascertain the comparative health of persons sorting different kinds of Wool, and find that the annual amount of sickness of the alpaca, mohair, and camel's-hair sorter, is almost double that of the British and Colonial Wool-sorter.

"The number of deaths from diseases of the lungs, excluding phthisis, in the Bradford registration district, of males aged twenty years and upwards, for the ten years 1851-60, was 17·4 per cent. of the total deaths at these ages. In the Shipley sub-district, where alpaca and mohair are largely used, the proportion for the five years 1872-6, was 68·2 per cent. This excess of deaths from lung diseases (nearly four to one) does nor apply to sorters of Wool in other sub-districts where these dangerous hairs are not used.

"Alpaca and mohair were introduced into the Bradford district as textile materials about the year 1837. It was not until some years had passed that a suspicion arose among the workpeople that they were injurious to health; this was confirmed by time, and the disease, which could not be accounted for, was found to be confined to the sorters, and became known as 'sorter's disease.' At places where these materials are used in large quantities, sudden deaths of sorters are frequent. When these occur singly, and at some weeks' interval, little notice is taken of them; when, however, several men working together in the same room die from this myterious disease within a short time of each other, considerable disquietude and alarm are caused among the workpeople, but only for a short time; the excitement soon subsides, and the work is continued. Men are willing to run the risk without complaint, and submit quietly to what they consider to be inevitable, although scarcely a month passes without the record of some death within the district from this disease.

"At various times, eminent medical and scientific men have been consulted by different firms; *post-mortem* examinations, investigations, and reports have been made over and over again, without satisfactorily explaining its cause and nature, or lessening its frequency. It has now prevailed and been recognised in this neighbourhood about forty years, and notwithstanding all that has been done to prevent it, by ventilation, the use of respirators, and other means, it still continues, as severe and frequent as it ever was, overclouding the life of the sorter with a mysterious shadow and threatening him daily with death."

Dr Bell then proceeds to say of the effects of the sorting of the chief disease-conveying foreign Wools:—

"As the result of careful inquiries, I may state that these hairs are not as yet known to communicate disease to persons who handle them in the countries where they are grown, they are not suspected on ship-board, neither do they affect those who work in warehouses where they are stored in bags. I have not heard of a case of suspected disease from these hairs before the bags have been opened by the sorter; neither have they been known to affect any persons beyond the packer who sometimes receives them from the sorters.

"It is well-known that Van mohair (from Lake Van district, Asia Minor), is the most dangerous; it contains more putrid materials and more fallen fleeces, than any other kind of these hairs. It frequently happens that such inferior qualities contain fleeces from animals which had been dead several days before the hair was removed from them. It has been torn ('sliped') off with the

epithelium, and has a strong fetid smell. Other samples contain much scurf, large scabs from sores, dried blood, pieces of skin and clay, burrs, maggots, beetles, lice, &c. These, when dried, cannot do much harm, but bales in transit may be damaged by water, ship leakage, or otherwise; after they have soaked and partly dried, the various animal matters decompose, so that when this has gone on for months in the interior of a hard-pressed bale to which the air has not free access, the activity of the dust poison developed will be at its maximum when the bale is opened; it will contaminate and adhere to the hair for some time after exposure, and endanger the lives of those who first come in contact with it.

"Sorters of these hairs are of two grades; bagmen and dagmen. The bagman opens the bags in which the hair is packed, shakes out the fleeces, spreads each on a 'board' in a good light and separates the fleece into six or eight qualities. The dagman looks over what has been done by the bagman, and corrects mistakes, or separates it into other qualities. The bagmen who open the bales are generally the victims to this disease, and rarely the dagmen. I have known a fatal case in a man who packed the Wool in sheets directly after it had been sorted. I have also known a sorter who re-sorted mohair after it had been in sheets for several months, die from a chronic form of the disease, but I have not heard of any case of disease from Wools or hairs after they have been washed. The infective power of these hairs gradually diminishes as they pass through the sorting room."

Dr. Bell, who has applied the most scientific scrutiny to the whole subject, adds that he has tried the effect of inoculation of animals with the poisoned blood of diseased men. Rabbits, guinea-pigs and mice all died a few days after they had been inoculated. It seems that the only hopeful means of warding off the disease is by steaming or washing the Wool in warm water before it is sorted, and this, seeing that the Wool has to be so washed soon after sorting, could not surely involve a very great difference of expenditure to the master with good management, which, in such a case and for such an object should surely be brought to bear. Yet we read :

"The sorters at one factory have gone on strike because the owners declined to have the Wool washed or steamed before sorting. A somewhat similar case was reported last year and had a very dramatic ending. A firm which had been in the habit of steaming its dangerous Wool, became too busy to afford the time. The sorters refused to work the unsteamed material, and their places were filled by others. Within a few days three men out of the twenty new sorters were dead. At another factory, three men out of nine working in one room died of the disease within a month of each other. The mortality in the district from diseases of the lungs is enormously high; and looking to the specific risks of blood-poisoning run by the workers, a strong case seems certainly to be made out for legislative interference with the trade."

BEDS.

THE story of Columbus's egg is often repeated in a survey of those little matters which historians are most apt to leave out. If we said that mankind had existed for more than five milleniums (reckoning by the Mosaic chronology) before anyone had enjoyed the luxury of sleeping in what we now consider a "comfortable Bed," we should not be very far wrong. Our modern Beds are the results of slow development; the outcome of very gradual changes. It is quite evident that a heavy assortment of bedding, such as feathers and eider-downs, would not have suited people devoted to a nomadic and pastoral life; but what is really surprising is, that the nations of antiquity, who produced works of art that we still admire, and whose poets and philosophers we still study and hold in reverence, should never have risen to the idea of a "proper Bed." Doubtless their sleep was sound notwithstanding; and that is the main point; so that we must not be too vain if a survey of the history of Beds discloses our great superiority in the matter of ways and means.

The earliest data we have concerning Beds are of Egyptian origin, and they are very slight. Sir Gardiner Wilkinson thinks that the Egyptians usually slept on their day couches, which were long and straight, sometimes with a back, sometimes with carving of the heads and feet of animals at the ends, made of bronze, of alabaster, of gold and ivory, of inlaid wood, and richly cushioned. Where these were not in use, mats replaced them, or low pallets made of palm boughs, with a wooden pillow hollowed out for the head. Wicker bedsteads, formed of the midribs of palm-leaves are found figured in Egyptian paintings, showing that at a very early age the Egyptians had reached to the height of attainment which is common still among their modern representatives. The head-rests, generally of wood, were sometimes also of alabaster, elaborately and ingeniously decorated, being mostly of a crescent shape. It would appear that among Asiatics in early times, the divan by day generally served as a sleeping-place by night. The ancient Jews seem to have outstripped many of their contemporaries in bedding, for we read in Scripture of very luxurious and beautiful Beds. What Egypt had, the Assyrian and the rest of the world had, and the Greek, whenever he could, improved upon other countries' notions; and the Greek couch, judging from the bas-reliefs on many vases, was of great elegance.

The Romans, although they derived many of their customs and much of their art from Greece, had very simple Beds until after their Eastern conquests. It will

be remembered how Shakespeare makes Mark Antony tell Pompey, on the latter saying that he did not expect just then to meet him:

> "*The Beds i' the East are soft;* and thanks to you
> That call'd me timelier than my purpose hither;
> For I have gained by it."

Beds which, with their pillows, were merely hollows in a slab of stone, have been found among Roman remains. But from the period when their Asiatic dominion increased, the Romans borrowed fashions from the conquered, and soon developed a strong taste for luxury, Beds not forming any exception. Examples of the Roman form of Bed were still preserved in the days of Charlemagne. These forms generally being lost in the barbaric life of Northern and Western Europe, it was an advance, when the bench became the Bed, and people were fastidious enough to feel above sleeping on thin bundles of straw or heaps of skins laid out upon flags.

Reeds or rushes seem in the early period of our country to have been universally used, this custom having been learned from the Romans during their invasion, superseding animal skins; but it was a long time before our forefathers advanced to the use of straw, not indeed till the period of their contact with the Italians, who had used it for centuries before; agriculture having been early advanced to a higher stage in that country, Straw was used in the royal chamber of the English monarch all through and up to the end of the thirteenth century; and was universally used in Wales up to a still later date.

This is the more surprising that the Roman patricians had used feathers, or the soft down of reeds at the period of the Roman invasion.

The Carlovingian monarchs and their courts made use of certain forms of bronze bedsteads, and these have been handed down to succeeding generations. People all but sat up in these Beds, so high at the upper end were the long mattresses lifted upon piles of cushions. Many of them had what we call the sofa back, and frequently, instead of other filling of the metal frame, straps of leather upheld the mattresses and cushions, like the

"sacking bottoms" of the last generation. In these Beds the sleeper lay altogether naked, rolled in the drapery, although there was sometimes worn, as the illustrations of the old manuscripts show, a curious

knotted head-dress. In a quaint old print which we reproduce specially for this volume, we find the sleeper represented with a crown which was of course meant to indicate that the occupant of this early Bed was of royal or at any rate of very high rank.

This was still the style of Bed that was common in the time of Chaucer; for in the middle ages, men's minds moved slowly towards change. The poorer people used the dress that had been worn through the day for sheets and coverlets; and only to the few was it given to enjoy the luxury of clean sheets. But already a more elaborate Bed and bedding had been introduced and was slowly making its way. We find a good authority on all such details of life in the time of Chaucer, writing thus, in speaking of the widow and her two daughters in "The Nonne Preste's Tale:"—

"The widow and her daughters perhaps covered themselves with their ordinary clothes at night, sleeping unclad and without anything that we should recognise as sheet or blanket. That people always took off the whole of their clothing, and without supplying its place by a night-dress before they went to bed, is not perhaps exact, but that was the prevailing practice, and certainly with people like this widow. That she and her two daughters slept in one room need not surprise us; for in the 'Reeve's Tale' we find the miller and his wife in one Bed, his daughter in another, and the two clerks in a third Bed, all in the same room. We are told that the miller made his guests a Bed, 'with schetys and with chalouns fair i-spred;' though this

is apologised for on the ground that there was no other lodging to be had:—

'Ther was no rommer herbery in the place,'"*

Mr. Thorold Rogers, in describing the Manor House of the period between 1259 and 1400, says, "The dormitory contained a rude Bed, and but rarely sheets or blankets, for the gown of the day was generally the coverlet of the night."†

After the twelfth century, the Bed was still made occasionally of bronze and other metals, but most frequently of wood, was carved and incrusted with ornament, sometimes inlaid, sometimes painted, and the mattresses themselves covered with rich stuffs of costly embroidery decked off with gold lace. Curtains of a corresponding richness were either suspended from the ceiling or carried by columns over the Beds. Lamps were always swung either within the curtained space or just outside, superstitions concerning evil spirits being very rampant in those days, and light being supposed to have some holy power in keeping them at a distance.

These Beds seem at first to have been quite narrow, but they gradually increased till they reached the width of something like four yards. In such huge Beds the parents and all the children, and sometimes the dogs, were wont to take their night's rest. It was considered the proper courtesy to invite an honoured guest to share them—a

* Chaucer's England. By Matthew Browne. Vol. II., pp. 6 and 7.

† Vol. I., p. 13.

custom which still obtained when Francis I. was able to do Admiral Bonnivet no further honour than by inviting him into his Bed.

In the thirteenth century, curtains were attached to the cross-beams, with or without an additional canopy between them, as the case might be. At this time the Bed stood out squarely in the room, with the head to the wall, and with both sides free, and nobody seemed to imagine the possibility of any other arrangement. It was only after so many various divisions of the original great hall had taken place, and space became an object, that it occurred to their owners to set them closely into a corner, certainly a much less healthy if more convenient fashion. To-day there is no rule in this matter, and we set the Bed as we please.

Before the Bed was pushed up closely in the corner, it was customary to have an alley between the Bed and the wall, an open space called the "ruelle." If one were ill, friends were received there, and to be admitted to the "ruelle" of the monarch's bedstead was a crowning favour. It was into the "ruelle" and beneath the curtains of the big Bed that the little cradle used to be taken at night. This cradle, by-the-way, was at first hollowed from the trunk of a tree, and rocked by its natural convexity; in its next shape it was an osier basket; and later on the cradles were little Beds placed on two pieces of bent wood; in the fifteenth century, boxed and slung on pivots. We read of a counterpane for a cradle furred with minever. Little holes were to be seen piercing the sides, through which to

pass the bands that held the child safely. Thus the child itself was bandaged like a chrysalis, according to a custom still prevalent in certain portions of the East, and in parts of Italy.

In the thirteenth century we see the bedstead standing low on four feet, with a surrounding balustrade and narrow

gateway open on one side. The Beds and the cushions were stuffed with straw husks or feathers, neither wool nor hair being then used. At this period sheets began to come into use; at first a single sheet was rolled about one; afterwards, two were laid flat upon the Bed, and hung to the floor as quilts hang, that is, not tucked in about the Bed. The Bed stood at that time still in the great hall, where the family assembled, where the serfs came to render account of their produce, and where the culprit was brought for trial. People of course, were still primitive in many of their tastes, loving gorgeous display, and they did not neglect so fine an opportunity for such an indulgence as this great Bed afforded. In the next century the structure of the article was hardly apparent, except for the carved and panelled head-board, so utterly was it envelopped in heavy draperies. The pane, as the coverlet was styled, was of silk velvet, cloth of gold, and all sorts of rich-coloured stuffs brocaded with silver and gold, and lined with furs; the counterpane was merely the double of the pane, that is, the original article lined; and in the complete equipment of the Bed there were "ciels and lambrequins, curtains, dorsels, pendants, counterpoints, mattresses, and pillows." The various pieces of a Bed of Henry the Fifth's time are enumerated in a schedule as "a selour, a tester, a counterpointe, six tapits of arras with figures of hunting and hawking worked in gold, and two curtains, and one traverse of tartaryn."

We do not find any mention of the bolster, although there were plenty of comfortable pillows in use before the

fifteenth century, at which time the Beds assumed their most extravagant proportions. It would seem not to have been in such common use as to suffer degradation when Milton referred to it as no poet would dream of doing at present: "Perhaps some cold bank is her bolster now." The interior of a bed-room in the early part of the fifteenth century is described as high and spacious, with a "large window at the end, approached by stone steps which form capacious seats at the side. In addition to the lattice-work, there are inside shutters for the purpose of keeping out the wind and rain. The walls are covered with richly embroidered tapestry hung on tenter-hooks, and the arras hangings are worked with fleur-de-lis. A chair displaying novel taste in its construction, with the back and cushions embroidered, is at the bedside, and a couch well cushioned and covered with arras gives an air of comfort and refinement to the chamber."

Fine as the Beds of the Middle Ages were, those of the Renaissance exceeded them in wealth. If there were "celers" on the one, there were double "celers" on the other, double curtains, and we hear of them with draperies of violet satin with raised figures in gold, and curtains of the cloth of gold again, lined with stuffs as costly. Cloth of gold, it should be understood, does not always mean literally cloth of nothing else but gold, but the gold filled one way of the web usually, some silken spun thread the other, as there was "cloth of gold of blue" and "cloth of gold of cramoisy," and of other colours. Some old chronicler complained of the luxurious fashions,

that people were no longer able to sleep under simple quilts, and that in the construction of the frame, cedar, ebony, ivory, silver, and more precious matters came to be freely used. The sheets were perfumed. "The gromes," as an ancient direction runs, "schell gadyr for the kinges, gowns and shetes and othyr clothes the swete floures, herbis, rotes, and thynges to make them breathe more holesomely and delectable."

There is one Bed, the Bed of Ware, which has become historical or even legendary. It was said to be capable of containing twelve persons, and tradition assigns it to Warwick, the King-maker. We learn that it is still preserved in an inn at Ware in Hertfordshire. It is more than twelve feet square; and has a remarkably curious and richly-carved back, which, by means of two massive pillars at the foot, supports a heavy canopy, enriched with elaborate carved work. Before the time of Shakespeare it was proverbial; for we find Sir Toby Belch in "Twelfth Night" saying to Sir Andrew Aguecheek about the writing of a certain letter:—"It is no matter how witty, so it be eloquent and full of invention; taunt him with the licence of ink; if thou thrust him some thrice it will not be amiss; and as many lies as will lie in thy sheet of paper, although the sheet were big enough for the Bed of Ware in England, set 'em down."

In the sixteenth century the Beds became columnar, and upheld the canopies and curtains that had previously been suspended in all their cumbrousness from the ceiling. There were Beds of state used on occasions of parade then,

very magnificent, on which sometimes the favoured few sat, but where no one pretended to sleep. There was always at this period one in the anteroom of the bed-chamber of a royal personage; and into the room where it stood were admitted those—the particularly honoured ambassadors from other courts, for instance—who were not exactly to be received in the bed-chamber, but were too important not to be treated with more distinction than the outside crowd. At about the same time the Beds were frequently placed in alcoves, which was a new fashion, the alcove being almost always curtained off from the rest of the room in which guests were customarily received. The appearance of the Bed now must have been something as picturesque as it was resplendent. Only when the many wallowed in squalor and laboured in poverty could such costly magnificence have been attained by the few. The bed-room of the Duchess of Dolfino had a ceiling of a fret-work of gold upon ultramarine. The walls, we are told, "were superbly carved and decorated. One bedstead had cost five hundred ducats, and the rest of the furniture was in keeping;" while in Prince Doria's palace at Genoa there were whole bedsteads of solid silver seen by the traveller who reports them, set with agates, cornelians, lapis lazuli, pearls, and turquoises.

All our readers will remember how strangely one is affected by reading that to his wife, Anne Hathaway, Shakespeare bequeathed his "best Bed," and how one was seized with some kind of vague suggestion that

Shakespeare thereby did her no honour. But a slight knowledge of antiquities helps to dissipate that idea. Beds had become the chief domestic glories by that time; and immense sums were spent to adorn them. They were even specifically named in the wills of the sovereigns and of the nobility. Anne, Countess of Pembroke in 1387, bequeathed to her daughter a Bed, "with the furniture of her father's arms." In 1368, Lord Ferrers left to his son his "green Bed with the arms thereon," and to his daughter his "white Bed and all the furniture, with the arms of Ferrers and Ufford thereon." Edward the Black Prince bequeathed to his confessor, Sir Robert de Walsham, a large Bed of red camora, with his arms embroidered at each corner, while to another friend he left another Bed of camora, flowered with blue eagles; and in 1385, his widow gave to "my dear son the King, my new bed of red velvet, embroidered with ostrich feathers of silver, and heads of leopards of gold, with boughs and leaves issuing out of their mouths."

Readers of French memoirs in the sixteenth and seventeenth centuries will remember that it was quite the custom for ladies of distinction, either by rank or beauty, or genius, or fashion, frequently to receive their more favoured visitors while still in Bed, or as a slight improvement on that hardly-to-be-recommended fashion, in their dressing-room, while they were being dressed; and one of the finest points in Voltaire's relation with the Marquise de Boufflérs is made while the two had met under these circumstances.

Feathers in our day, have given place to horse-hair, wood bedsteads have yielded to those of iron and brass—changes which are much in favour of ventilation and perfect cleanliness. Above all, steel springs skilfully arranged, and small coils of wire woven by an ingenious process of double weaving have been found advantageous for the bottoms of Beds, and air Beds and water Beds are in vogue for many exceptional cases.

Where in the old days there was one Bed of clean comfort, there are now a thousand. There is no worthy or industrious citizen of this country, however humble, who has not his comfortable Bed and his clean sheets, and who cannot enjoy his rest as luxuriously as any of the old feudal nobles could, but as none of the dependents might.

Thus we see that, in a broad and general way, the tendency towards grandeur and imposing aspect soon came into conflict with the laws of health. As the Bed expanded and became artificial, it slipped away from the advantages possessed even by the early sofa form, with the back that compelled a half-sitting posture. There, at all events, one person was kept at a "respectful distance" from the other; so that they did not inhale each other's "breathed breath." This was a vast advantage. Science, which is more apt to reveal our own advancement than to re-assert the wisdom of our ancestors, is in this respect, calling us back to the practice of earlier times. Such a thing even as a double Bed, should not exist, not to speak of the habit of several persons sleeping in one large Bed—the box-bed of the Scotch, being simply intolerable. Its

evil consequences could only have been compensated, in some degree, by much open air through the day and healthy feeding, as we know is generally the case among the Scotch people, else their physique could not have been so well maintained. The hateful box-beds have certainly not helped it. Having historically described the couch from the sofa-backed Beds, on by the gigantic enclosures for whole families, like the Bed of Ware, the single Bed must once more have the preference; and so far we shall be like the earlier sleepers. Dr Richardson, as well as others, earnestly urges this reform. He wrote recently to this effect in *Good Words;* and we are sure he will gladly allow us to make an extract embodying his leading points on this head:—

"To the fact that no two persons are constituted to require the same kind of clothes and the same kind of bedding, may be added the further fact that no children or persons can sleep under the same covering, without one being a cause of some discomfort to the other, by movement, position, or drag of clothing. Beyond these discomforts, moreover, there is the question of emanations from the breath. At some time or other the breath of one of the sleepers must, in some degree, affect the other; the breath is heavy, disagreeable, it may be so intolerable that in waking hours, when the senses are alive to it, it would be sickening, soon after a short exposure to it. Here in bed with the senses locked up, the disagreeable odour may not be realised, but assuredly because it is not detected, it is not less injurious.

"I need not pursue this subject much further, common sense will tell everybody who will reflect on the subject with common sense, that I am correct, and that it is best for persons of every age to have to themselves the shelter within which they pass one-third of their whole lives—thirty years of life if they live to be ninety years old. I dwell, therefore, only on one point more in favour of the single Bed, and that is to enforce the lesson that under the single Bed system, it is rendered impossible to place very old and very young persons to sleep together. To the young this is a positive blessing, for there is no practice more deleterious to them than to sleep with the aged. The vital warmth that is so essential for their growth and development is robbed from them by the aged, and they are enfeebled at a time when they are least able to bear the enfeeblement.

"The single Bed for every sleeper determined on, the size of the bedstead and the number of bedsteads in the room, according to space, should be considered. For ordinary adult persons the bedstead need not exceed 3 feet 6 inches in width by 6 feet 6 inches in length; and in no room, however well it may be ventilated, should a bedstead be placed in less than a thousand cubic feet of breathing space. A bed-room for two single beds should not measure less than 16 feet long by 12 feet wide and 11 feet high. There are some sanitarians who would not be satisfied with those dimensions for a room to be occupied by two persons, and I frankly admit the dimensions are close to the minimum, though with good ventilation they may, I think,

suffice. With bad ventilation they are confessedly out of court, and I name them merely for the sake of meeting the necessities of the limited bed-room space that pertains to the houses of great cities. In my own mind I do not consider twice the amount of space named at all too much, even with the ventilation free and good.

"There can be no mistake that the bedstead should be constructed of metal, of iron or brass, or of a combination of those metals. Wooden bedsteads are altogether out of date in healthy houses. They are not cleanly, they harbour the unclean, and they are not cleansible like a metal framework. The framework of the Bed should be so constructed that the Bed or mattress is raised two feet from the floor of the room, and the whole framework should be steady and so well knit together, that the movements of the sleeper shall cause neither creaking nor vibration.

"A good deal of controversey has been raised on the matter of curtains for Beds. From the old system of curtains all round the Bed, like a tent, there has been a reaction to an entire abolition of the curtains. I am of opinion that this complete change is not beneficial. Two light side head curtains, with a curtain at the back of the head and a small tester, are, I think, very good parts of a bedstead. The curtains fulfil a doubly useful purpose; they shield the head and face of the sleeper from draughts, and they enable the sleeper to shut out the direct light from the window without in any way necessitating him to shut the light out at the window itself. The room may be filled with light, and yet the sleeper may be shielded from

the direct action of it upon his eyes if he have the curtain as a shield.

"The kind of Bed on which the body should rest is a question on which there is extreme divergence of opinion. Whenever we leave our own Bed to go to sleep elsewhere, in an hotel or in the house of a friend, it is almost certain we shall find a Bed differing from that to which we are accustomed. We may find a Bed of down so soft that to drop into it is like dropping into light dough; we may find a soft feather Bed, or a soft mattress, or a spring mattress, a moderately hard mattress, or a mattress as hard, I had nearly said, as the plank Bed for which our prisons are now so unenviably notorious. These differences are determined by the taste of the owner of the Bed without much reference to principle, or to the likings of any one else in the world; not a very good or satisfactory state of things. There ought to be some principle for guidance in a trial so solemn as that which settles the mode in which our bodies shall rest for a third of our mortal existence.

"I fear it is hard to fix on definite principles, but there is one principle, at any rate, which may be relied on, and which, when it is understood, goes a long way towards solving the question of the best kind of Bed for all sleepers. The principle is, that the Bed, whatever it be made of, should be so flexible, if I may use the term, that all parts of the body may rest upon it equally. It ought to adapt itself to the outline of the body in whatever position the body may be placed. The very hard mattress which yields nothing, and which makes the body

rest on two or three points of corporeal surface, is at once excluded from use by this principle, and I know of no imposition that ought to be excluded more rigorously. On the other hand, the bed that is so soft that the body is envelopped in it, though it may be very luxurious, is too oppressive, hot, and enfeebling; it keeps up a regular fever which cannot fail to exhaust both physical and mental energies, and at the same time it really does not adapt itself perfectly to the outline of the body.

"The best kind of Bed, taking everything into consideration, is one of two kinds. A fairly soft feather Bed laid upon a soft horse-hair mattress, or a thin mattress laid upon one of the elastic steel spring Beds which have lately been so ingeniously constructed of small connected springs that yield in a wave-like manner to every motion. It is against my inclination to try to write out the time-honoured old feather Bed and mattress, but I am forced to state that the new steel spring Bed is, of necessity, the Bed of the future. It fulfils every intention of flexibility: it is durable; it goes with the bedstead, as an actual part of it, and it can never be a nest or receptacle of contagion or impurity.

"On the subject of bed-clothes, the points that have most to be enforced are, that heavy bed-clothing is always a mistake, and that weight in no true sense means warmth. The light down quilts or coverlets which are now coming into general use are the greatest improvements that have been made, in our time, in regard to bed-clothes. One of these quilts takes well the place of two blankets, and they

cause much less fatigue from weight than layer upon layer of blanket covering.

"It is a practice too easily acquired to sleep under so much clothing that the body becomes excessively heated, feverishly heated. This condition gives rise to exhaustion, to disturbing dreams, to headache, to dyspepsia, and to constipation. It is so injurious that it is better to learn to sleep with even too little than too much clothing over the body. This, specially, is true for the young and the vigorous. It is less true for the old, but in them it holds good in a modified degree.

"The position of the Bed in the bed-room is of moment. The foot of the Bed to the fireplace is the best arrangement when it can be carried out. The Bed should be away from the door, so that the door does not open upon it, and it should never, if it can be helped, be between the door and the fire. If the head of the Bed can be placed to the east, so that the body lies in the line of the earth's motion, I think it is in the best position for the sleeper."

A PIECE OF PORCELAIN.

Like a good deal else both in the works of nature and industry, the beautiful Porcelain which adorns our tables and mantel-pieces had a harsh and unexpected beginning. It does not rise at the bidding of the skilful potter from clay found ready-made in the bosom of the earth, but is dependent on the nice choice and careful adjustment of several elements, which are drawn from different places and demand very different treatment, ere they come before us compacted into the beautiful clay that takes the shining shapes we so much admire. Porcelain is broadly distinguished from earthenware through being a semi-vitrified compound; one portion of it remaining infusible while the other fuses, and, combining with the infusible part, forms a smooth, compact, and semi-transparent substance. It is this vitrification to which it owes its lustre and transparency. In China, where for ages Porcelain of a very fine quality has been made, a peculiar clay was found in the earth, which greatly simplified the earlier processes for the Chinese potters; and in the

development of the industry in Europe, research and invention have done their utmost to discover a more direct process than has yet been attained. Hence probably the popular error by which the name was traced to the French *pour cent années*, instead of to the Portuguese *porcellana*, a cup, based on the idea that the materials of which Porcelain is composed required to be matured underground for a hundred years. The bulk of the materials do indeed require long maturing in the earth, but the origin of the name could hardly have sprung from that. Not the least interesting part of the manufacture, as we are fain to think, is the initial process of clay making. Some time ago, we had the privilege of a leisurely walk through one of the largest and most famous Porcelain works in England, under the conduct of a guide well able to explain to us all the outs and ins of the manufacture, and we, in our turn, shall now make the endeavour to familiarise others in some measure with what proved of the greatest interest to ourselves.

Instead then of being led at first to the ancient and romantic potter's wheel, we are conducted to a row of blazing kilns or furnaces where various substances, as we see, are being calcined. Animal bone and Swedish felspar, and flint, are the chief, and they are submitted to the action of fire for the space of fifty hours or so, when to the superficial eye they have undergone a change more or less marked. The flint in particular comes out white. The necessity of this process is perceived the moment we pass into the next chamber. Here are a series of shafts

driving heavy wheels of granite round and round in gigantic tubs, somewhat like the old-fashioned mill-pans, amidst white clayey-looking substances. This is the grinding. The various constituents for Porcelain are here put through a series of these pans till they come out so fine a powder as, when mixed together in water, to pass through silk sieves with 3000 meshes to the square inch. Whatever is left as a residuum is ground again. About eight days is the period required for these repeated grindings, and then we have the prepared constituents of the fine clay. For common white china the principal ingredients are Cornish granite, Cornish clay—which is, in fact, decayed granite—and calcined animal bone. For the parian body, that is, for such pieces of Porcelain as miniature statues and the rest, which are not glazed or painted over but remain white, the Swedish felspar is substituted for the calcined bone. After the liquid clay has been tested by the sieve, it is run through a magnetic box while in a liquid condition, all particles of iron, &c., now being extracted from it in the process. And this is most necessary, for even a hair or a grain of sand would spoil the whole work. As the clay comes from the magnet-box it passes into a hydraulic press that the water may be squeezed out of it, leaving it only moist. For what is called the opaque body, common flint is used. A composition of borax, salt, tin, flint, and Cornwall clay, is formed for the purposes of glazing, through which all the decorated work is carefully passed.

And here arises a very interesting point. The glazing

is necessitated as much to prevent evaporation as for ornament. Indeed it is possible to have a good deal of ornament without complete glazing, as is seen in various kinds of water-bottles, and wine and butter-coolers, where the porosity of the clay, favouring evaporation, is a medium of coolness. Glazing is simply a filling up of these pores with glass more or less fine. The composition of the glazes as we have seen, is metallic oxide in one form or another, potash and soda, most frequently in the form of salt; and these decomposing and combining with the silica of the clay really form a glass. For the sake of cheapness lead is often used in glazes; but the glazes so produced are poisonous and deleterious in many ways. No doubt the first potters realised as a great drawback what now we often seek to attain as an advantage for certain purposes. Glazes did not come into vogue till long after pottery was in fashion, and indeed in the East porousness in pottery would be an advantage; but we do not know by whom it was first used. In Assyria, Egypt and Greece, at very early times glazed pottery was in favour.

The science of mixing earths to attain a peculiar fineness and semi-transparency was a thing of slow growth. The early Egyptians we know, used the Nile mud; but this clay produced only a very common and brittle pottery; but, by and by, in Egpyt other matters were added, more particularly silex, in the form of sand, and this, vitrifying under the heat, supplied the very elements that had been wanting; and met two great desiderata, first, with respect to tenacity, and next, with respect to porousness, which

will perhaps be understood when we say that, even if a small proportion of sand be mixed with the commonest clay, it will, to a certain extent, do the work of a glaze, producing more or less of impenetrability by moisture.

We should not have omitted to notice the circumstance that the charcoal in the bone has the effect of giving the clay a dark colour; so that when bone forms an ingredient, the finest clay is anything but white as it passes through the hand of the potter—to recover its whiteness, however, in the burning. And having now seen the ingredients properly mixed to form the clay, our next step is to the potter's wheel.

Here we have an exact reproduction of the pictures of early Egyptian or Biblical times. The potter's wheel, turned by a lad or a girl at a little distance, has not deigned to be wholly superseded as yet by all the scientific thought that has been brought to bear upon invention. Here it is the same as it was in the young days of the world, holding its own amongst the most intricate modern appliances. It is like a link, relating the earliest life with our own, and excites a peculiar interest. A woman called a "baller" cuts the clay into the proper size, and lays it near the *thrower* or potter. The band round the wheel moves a wooden revolving disc right before him. He takes a piece of clay in his hand, sets it on the revolving board, first draws it up into a pillar-like form, and then depresses it quite flat to get rid of all air-bubbles, and by the deft guidance of his fingers, or by aid of the simplest tool, it finally rises as it spins before him into the shape he

desires. It is then cut from the table with a metal wire. It seems more like magic than the result of any effort of will, with such dexterity and by such simple means is the process accomplished. But the potter at his wheel can only form the main body of the vessel; in the case of a cup, or a jug, or a vase, the handle is formed independently. A teapot, for example, is formed in four parts, of which only the round body is *thrown* or fashioned at the wheel; the spout, the handle, and the lid being, as we shall see, done differently.

As we look at the potter exercising his craft, we can fully realise how, as the early workmen grew in skill, they would vary the monotony of their labour by adding ornament. At first, doubtless, it was merely the circle or ring. The potter had only to hold his nail steadily against the circumference of the vessel while it revolved, and a complete ring was formed—the same principle, as we shall see, is adopted in the production of all the circular lines of colour on the fine ware—the earliest workers thus anticipating the latest. Specimens of the very oldest pottery are found ornamented with rings round the neck, the foot, and the body of the vessels, in all probability thus formed. Afterwards follow double or treble rings, and then whole clusters of them, neatly done with the nail; and at a later stage, soon succeeding, we have either sunk rings or raised beads formed by the simplest tool.

After the first formation of any article on the potter's wheel, it is passed through a plaster-of-Paris mould, which absorbs the superfluous water from the clay, and the correct

shape is then given to it on a lathe, similar to an ordinary turning lathe. The delicate indentations and lines and round raised edges on such articles as candlesticks, as well as on cups and other vessels, are produced by the touch of a tool or knife, very similar to a turner's, as the lathe revolves. The great expertness that is acquired in this branch of the work is also wonderful. The separately-made handle is passed through a separate mould, and is attached to the vessel while still moist. Water with a camel's hair pencil suffices to smooth down the joining, and the burning in the kiln thoroughly unites the pieces. Very large vessels can be finished on the wheel—one half being done at a time, and the parts afterwards united by the cement.

For flatter articles, such as plates, cakes of clay are rolled out on moulds which have the form of the interior of the plate, and against this are pressed profiles with the outline of the inside of the article. But for certain branches of the manufacture, the potter has actually been superseded. Even here the refinements of modern life make inroads, and have modified, and are modifying, the old paths of pottery, as of so much else. For statuettes and various kinds of figures, or for ornamental devices of a larger kind, it is found desirable to cast them in a number of pieces—varying from five or six up to eighty or even ninety—and for this purpose a modern method has been found most efficient and economical. A liquid of about the consistency of cream is run into a mould specially prepared for the purpose. The material of the mould

absorbs the water, and attaches the clay to it. A coating of equal consistency is thus left on the mould throughout, and this coating actually forms the article or the piece desired. By this process articles are cast in many separate portions, and then united together with a cement specially prepared. Some of the finer and larger vases thus pass in parts through the hands of as many as thirty or forty persons. In this case the articles leave the mould in a very rough and unfinished state, and all the finer ornamentation is afterwards done by hand—a department of the work which, as may readily be conceived, demands great skill and practice; since the very finest vessels are now produced in this manner.

We next pass into what is called the *placing-room*. Each piece is here put into a round mould or crucible of strong earthenware, called a "saggar," and supported by very fine ground flint, to keep it exactly in position. As the articles in the burning contract a sixth, this proportion is always allowed in the size for contraction. It is a very peculiar fact, that deep round vessels, like tea-cups, would not maintain their circular form near the lip under the force of the fire; and a curiously-simple device has been hit on to meet this tendency. A little circular ring, of the same material, made, in fact, out of the waste clay, and so formed as to rest on the lip of the vessel, is placed on every such article in the crucibles; and this is found effectually to prevent all unequal shrinkage and contortion—the circular form being beautifully preserved.

And now we come to the *burning*, a part of the work

which demands the utmost skill and care. A heat too intense or a few minutes too long in the kiln might spoil the whole contents. The kilns are large round buildings of brick, narrowing upwards, and the articles in their crucibles are stored up on each other in high towers; so placed on each other that no part of the Porcelain is directly exposed to the fire, or likely to be injured by dirt or smoke. The pillars of crucibles built on each other are set so far apart that the heat may the more speedily be equally diffused through the whole kiln. It takes, on an average, two days to fill a kiln, when five or six men are engaged in the work. Directly it is filled the doorway is built up with double rows of bricks, and a coating of mortar to make it quite air-tight. The fire is kept up for about 48 hours.

But it may be asked, how can the exact heat of the kiln and the stage of the burning be directed? It is done in this way:—Round the kiln, at equal distances at a certain height, are small apertures, in a slanting direction, and through these the men in charge, with long tongs, can draw out little rough round vessels of clay, placed there as "proofs," and when these have become burnt and transparent the oven is put out. The kiln then requires two days to cool, and about the same time to empty.

Each piece, on being taken from the crucible, is what is called scoured, that is, rubbed both outside and in with very fine sand-cloth, to remove the particles of flint-dust that may have adhered to it in the burning. The Porcelain in this state is called *biscuit;* and much resembles

unpolished marble. Such pieces as are meant to remain white, are now carefully scoured, polished, and finished off; the others after having been scoured, are dipped or washed in the glaze which we have described, and then taken wet into a hot room, on purpose to draw the bulk of water from the glaze. The porousness of the biscuit ware absorbs the moisture and dries up the film of glaze so as to insure uniformity; after glazing, the articles are put in similar crucibles to the former one, only supported by a roll of clay instead of flint dust, and are burned for twelve hours, in a "glaze-kiln;" the purpose of this burning being to fasten on the glaze and to give surface.

The pieces which are destined to receive the most elaborate painting and gilding now pass into more skilled hands. The plain circular lines of colour or of gold are painted, as we have already hinted, by turning the plate on a wheel with a brush in the hand kept steady at one point. Simple as it seems, perfection in this is the result of long practice. Certain colours are first put on merely to form an effective basis for gold; and those which are called "raised colours," require to be burned before the article can be touched with the gold, and are so prepared that they fuse with the glaze in burning. The gold again is not put upon it *pur et simple,* but is conveyed in a solution of mercury. The mixture is thus discoloured and very un-gold-like so long as it remains wet; but under the action of the fire, to which it is again exposed, the mercury takes wings, in conformity with its name, and leaves pure dull gold. This is afterwards burnished with blood

stone or agate stone, which brings out every portion of it clear and bright. Women are largely employed in this portion of the work. Articles which are to have fancy designs upon them of flowers or other objects, involving numerous colours, are submitted to a special body of artists, who paint on what of the colours can be burned in together; and then others and others till the design is complete. These later burnings, however, become less and less severe, not generally lasting longer than six or seven hours. On an average there are six or eight burnings for each piece; and in the case of the very finest ware, painted in delicate colours, there are as many as twelve or fourteen burnings, with the risk of breakage increasing at each stage. On some of the cheaper kinds of ware, the outline is transferred to the Porcelain by an adaptation of the principle of steel-plate printing. The colour is first transferred to sized paper from the plates, and then the pattern is cut out, so as to be attached to the articles, which hold it with great tenacity. After a short time the paper is wetted and removed, and the pattern is left quite clearly outlined on the article, and is afterwards painted over and then burned in. Some of the more carefully executed specimens of this kind of work are good imitations of the genuine hand-painting in certain patterns; but the great bulk of it is very easily distinguishable by the peculiar character of the thin flowing lines. Women and young girls do the greater part of this work.

Piercing has recently become very common in finer work; a network pattern being cut out right over the

surface of the clay while it is still wet. Some very exquisite designs of this kind were produced at Worcester for the recent Paris Exhibition. Generally the design is exhibited in outline on the mould; but the best workmen, through skill and practice, can now do the most intricate network without pattern; and indeed produce the most valuable work independently.

We should not omit to add that the heavier plates and dishes are formed on a model or mould, supported on a revolving shaft, and this is fixed at the side of the table on which rests the clay.

There are many peculiar circumstances connected with Porcelain and the history of the development of pottery in its higher branches. We all know something of the rage which possessed our ancestors to procure specimens of the famous Sèvres or old Dresden or Worcester, or other wares, with which they adorned their cabinets, a passion which has in our day had a remarkable revival. The enthusiasm that the subject can excite in the producer as well as in the collector is well seen in the histories of Palissy and of Wedgwood, whom Mr Gladstone did so much to make known to us. At the earlier factories in Europe the secrets of the manufacture were jealously guarded, the workmen being solemnly sworn not to divulge them, but self-interest triumphed, doubtless for the public benefit, and potteries were established in many places. By no means the least entertaining parts of the history are accounts of the rivalry of contending factories. Berlin, for example, could not bear the thought that it

should to all time be surpassed by Dresden even in this manufacture; and a Porcelain manufactory was therefore established in Berlin as a department of the public service. Failing in the direct support that was expected, it was subsidized by the wary Frederick the Great in a most effective and significant manner. An act was passed compelling every Jew in the Prussian dominions, on his marriage, to purchase 300 thalers' worth of Porcelain; or rather he was required to accept whatever was sent to him, and to pay the money meekly into the treasury. It was a new and ingenious way of raising a tax, and of imposing a new disability on a much persecuted people, who, luckily, could flourish in spite of all such disabilities. But it is with some sense of the humorous irony of the situation we read that to the lot of the good and great Moses Mendelssohn, the modern Jewish reformer, who was very slight of stature and much deformed in the back, fell a great number of monkeys, which, as we are seriously told by the last biographer of the family, have been carefully preserved as heir-looms. Many articles of Porcelain carry with them a family history—but few surely such a grim record as the monkeys of Moses Mendelssohn—that "have been carefully preserved as heir-looms."

Happy chance in this, as in other industries, has sometimes done as much for improvement as the most careful experiment. One instance may be cited: A Burslem potter, named Astbury, in 1720, passing through Dunstable, had to seek the assistance of an hostler for a disease in his horse's eyes. He noticed that the man took

a piece of flint, burned it, and then reduced it to a fine powder, which he blew into the horse's eyes. Astbury noticed the beautiful whiteness of the powder, and conceived the idea of using it in pottery, which he did with great success.

As the most common of china tea-cups and saucers, as well as dinner-plates and dishes, pass through the earlier stages very much in the same manner as the most exquisitely painted and gilded ones, we are fain to believe that in the case of many of our readers a new interest may be awakened in them when they look on articles so necessary and so useful in every-day life—articles which have passed through so many stages, and been touched by so many hands, and have thus imparted to them something of individual history.

NEEDLES.

THE familiar Needle too might engage the antiquarian. In one form or other it is of the highest antiquity. If the first act of man is to clothe himself, whether as some say for ornament or symbolism, or merely for protection, he must first find a Needle of some sort. This may be taken as established, and pre-historic "finds" are the proof. Remains of sewed garments and a rude kind of bodkin or Needle of bone are found among pre-historic remains of many countries. To the present day the Esquimaux use Needles of bone for sewing together the skins which form the garments they wear. Although Needles generally consist of straight pieces of steel wire, having a hole or eye through one extremity, and brought to a fine sharp point at the other, yet for various purposes the form of the Needle is much modified. Thus the essential feature of the Needle of any sewing-machine consists in the eye being brought as near as practicable to the point, and therein lies the peculiarity on which the invention of the sewing-machine depended. The Needles of some sewing-machines

are curved, and, indeed, present such a peculiar aspect that an innocent person might be disposed to fancy a joke was being perpetrated on him when he is asked to accept such a monstrosity as a Needle. A curiosity about Needles, fed by some little study of their ancient history, led us to undertake a journey to the centre of the Needle-making district to behold for ourselves the various branches of the industry as practised nowadays.

Redditch, which stands as metropolis to this district, is a very clean and beautiful little town in Worcestershire, with a population of about eight thousand. Nothing in the distant view of it, as it lies on the slopes of a gentle elevation, would give the impression that it has made itself remarkable as the centre of an important industry. It is true that glimpses may be caught of a tall chimney-stalk or two; but the atmosphere is so clear, and the air of rural quiet so uninterrupted, that had you not been already aware of its unique pre-eminence, you would hardly have guessed it from such a prospect as we suggest. The bulk of its inhabitants—men, women, and children—are in one way or another connected with the Needle manufacture. Redditch indeed claims the merit of making, with very slight exceptions, all the Needles for the United Kingdom, as well as for many of the colonies and other parts of the world. We carry a letter or two with us, to make access easier where we want it, and after a general look round the town, we walk down the hill, past the post-office, towards the British Needle-mills, a solid and beautiful cluster of buildings partly erected within the past few years, which

certainly do no little credit to the proprietors, Messrs Samuel Thomas and Sons.

Having entered and delivered our credentials, opportunity is taken to convey to us some general notion of the Needle manufacture—its extent, recent improvements, the raw material, the growing competition, and so on—by way of preparing us the better for the walk round the workshops, which is fixed for early next day; as in order really to see well every stage of the process, we are assured that the best part of a day will be necessary. Our present intention is, as well as we can, to enable our readers along with us to follow the interesting and varied history of a Needle, as unfolded to us in the British Needle-mills.

Much in the quality of Needles depends on the wire from which they are made. This is of steel, and is mostly drawn at Sheffield in coils, varying much in thickness according to the "numbers" of the Needles to be made from it. When we step into the wire-room at Messrs Thomas and Sons' factory, we see wires of all sizes carefully papered suspended on bars round the walls. The thinnest seems hardly thicker than a hair; the thickest, used for packers' Needles and sail-makers' Needles, is perhaps three-quarters of an inch in circumference. This room itself is constantly kept at an equable temperature by currents of hot air, for the least damp might speedily injure the wire. The length of wire in each coil varies according to the diameter. Even for the ordinary numbers of common sewing Needles, that is, from No. 1 to No. 12, there is a considerable range, twenty-two thicknesses

of wire being found in the coil for Needle No. 1, while in that for No. 12 there are no fewer than two hundred thicknesses. The coil of wire from which a No. 6 Needle is made weighs about thirteen pounds, and when uncoiled is a mile and a quarter long, and this will produce from forty to fifty thousand Needles.

The first process in the manufacture is the *cutting*. This used to be accomplished by means of a giant pair of shears fixed into the wall. As both the hands of the workman were required to hold firmly in the shears as many as a hundred pieces of the wire, gauged to the exact length of two Needles, he brought pressure on the blades by the thigh and foot in a sort of stirrup-like contrivance. An automatic machine has, however, been recently brought into use for this purpose. Having been cut, the lengths are next gathered up, and are put within two iron rings, at a certain distance apart from each other. In this position they are set on a shelf in a small furnace, and remain there till they are brought to a red heat, when they are drawn out and placed on an iron plate. A piece of smooth iron is then inserted in the rings, and the wires are moved backwards and forwards, rubbing the one on the other, each being made to roll over on its own axis, till, by a peculiar change in the sound caused, the workman is informed that the desired end is accomplished, the wires being now perfectly *straightened*.

These straight pieces of wire are next *pointed* at each end. And here a very admirable example of the victory of machinery presents itself. Up till quite recently the

pointing was done by hand. At a grindstone, slightly hollowed out in the centre, sat a workman who, holding fifty or sixty of these wires in the palms of his hands, parallel to each other, presented them in such a way to the revolving stone that they were made to rotate. All parts were thus subjected equally to the influence of the stone, the wires being adjusted every few minutes against an iron plate. A good deal of skill was required in this work, and there was also some risk in it. The exposure to dust, which penetrated the chests of the workmen, made this, in truth, a very trying kind of labour, and the workmen were themselves not unfrequently indifferent and disinclined to take the precautions that might have been taken to preserve health. But a recent invention of a pointing-machine has done much to remedy this evil. The machine runs over the grinding-stone, which has been carefully ground hollow towards the centre; nothing is required of the workman but to put the wires regularly into a little trough, from which they pass on a kind of band into a case, which is so ingeniously designed that during their almost momentary stay there, they are made to rotate on the centre hollowed stone precisely as by hand. The sitting position close to the stone is now rendered unnecessary on the part of the workman. In a large factory like that of the Messrs Thomas, a great deal of pains and care is devoted to the preparation of these stones, and not a few, as we can bear witness, had to be rejected as imperfect, after no little work had been spent upon them.

The *eye* of the Needle is a most important point—as important as the *point* itself. Every lady knows that some Needles cut and fray the thread much more than others, and that others again are very apt to snap at the eye. These faults arise mainly from want of due care in the work of the next department to which we are introduced.

We are now in what is called the *stamping* shop. The stamping machine consists of a block of stone, a bed of iron on its upper surface, on which is placed the under half of a die or stamp; while above is suspended a hammer of at least thirty pounds weight. On the face of this hammer is fixed the other half of the die in true position. The hammer is regulated by a lever, which is directed by the foot, and can be brought down with great precision upon the iron bed. The wires which the workman now has in his hand are dropped, one by one, with the greatest exactitude into the iron bed, and, by the motion of the foot, the hammer is brought down at the same instant; the wires as they are released from it dropping into an iron pan kept there for the purpose. This stamping produces the channel or "gutter" in the head of the Needle, and also a slight depression to indicate the exact spot for the eye. One stamper, we were informed, could do as many as 4000 of these wires (that is, 8000 Needles) an hour, notwithstanding that each one has to be separately placed upon the *die*.

The "gutter" of the eye having been thus produced, the next process is the *piercing* of it. This is done by

boys, each of whom has a little hand-press. A number of wires are taken up and spread out at the one end, and in this position they are laid flat upon an iron slab, the collected ends of the whole being kept in the hand; while at the middle they are brought through the press, and, stopping for an instant at the right position, two hardened steel points descend and clip out two little bits of steel, and thus the eyes are made. This work needs good eyesight, and also very deft hands—needless to say also that it requires close attention, though habit in such cases seems soon to become second nature.

The work of the next department caused us a momentary surprise. A dozen or so of boys we see are busy in running two "spits" through the eyes which have just been pierced; and when these "spits" are filled, and the ends of the wires drawn tightly together, they present something of the appearance of a metal comb. This operation is called *spitting.*

The next bit of work is called *filing.* Its object is to remove the raised ridge caused by the *stamping* for the eyes, which, as we see, the comb-like form presents near the middle. The Needles on the "spits" are slipped under a kind of clamp, meant to hold them down firmly at the edges; and this elevation is very quickly filed down by experienced men, who certainly can calculate with great precision the exact amount of pressure that is needed from

the file to effect what is wanted. These ridges having been filed down, as well as a line made in the centre, the workmen, while the wires are still on the spit, take them by the points, bend—in the middle either way, and, working thus for a moment or two, the "comb" parts in halves exactly in the middle, showing us something really more like Needles.

But once more the Needle, notwithstanding all these manipulations, has to undergo the action of heat. Now come the *hardening* and *tempering*. After a very careful examination, the Needles are spread out on regular thin plates of iron, and are placed in a furnace, and gradually brought up to a white heat. When they are taken from this furnace they are transferred to a perforated vessel, which is immersed in oil or in water, and here they remain till quite cool. This completes the hardening. The Needles which have been immersed in oil require to be washed in some alkaline liquor, but if in water only they have simply to be dried. The tempering which follows is accomplished by their being placed on an iron plate, which is heated from beneath; and here they are moved about till a certain temperature has been reached.

In tempering, the action of the heat sometimes has the effect of slightly crooking the Needles, and it is therefore requisite that they should be *hammered straight*. This is accomplished by women, who, seated at a long bench, with a hammer in hand, place any defective needle on a small steel block before them with a smooth surface, and, by a few gentle strokes of the hammer, bring it exactly

straight. The lighter parts of the work such as this—in which women and boys and girls take part—are all carried on in the upper floors; but the Needles in the course of their progress through the works are moved up and down several times. Now, therefore, we have to follow the Needles down to the ground floor once more, to see what is perhaps the most striking and interesting of all the processes. This is the *scouring*. The Needles, by the exposure to fire, oil, &c., have lost the beautiful steely polish which we saw on the wire at first, and look dull, dark, and discoloured. Here we see men putting together large bundles of Needles, carefully laying them all parallel to each other the long way on the piece of rough canvas on which they lie; next putting in beside them a mixture of soft soap, emery sand, and oil; and finally packing them in a long roll, which is afterwards very carefully and tightly corded. These rolls are then put under rolling machines, which are very much like the good old-fashioned mangles, but driven by steam-power. Two rolls go in each machine, and the Needles are thus wrought in the rolls from six to eight days, according to their quality; being, however, several times during that period taken out, washed in soap-suds, the soft soap, emery, and oil being renewed. The dexterity with which these washings are accomplished is something really extraordinary. When the Needles are taken out of the soap-suds they are put into a kind of sieve, and shaken with so much art that the Needles arrange themselves parallel to each other, and are easily lifted out and repacked up.

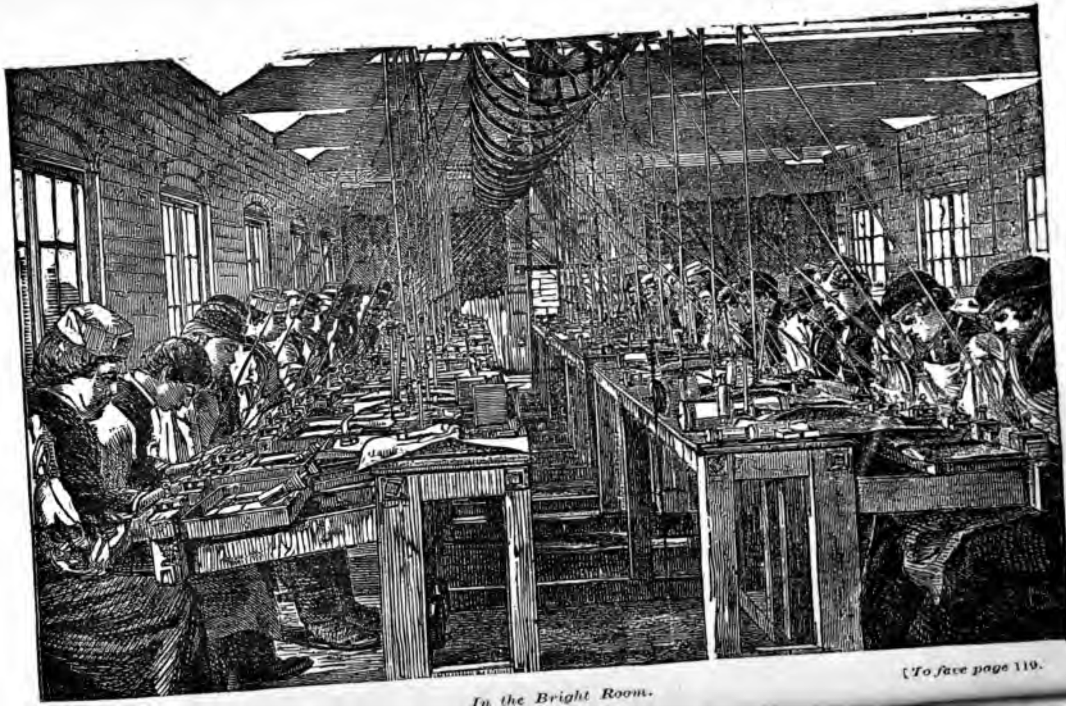
When they are taken out of the cloth for the last time they proceed to what is called the "Heading-table," and are given in charge to a "header"—a girl whose business it is to turn all the heads one way and the points the other. It is truly astonishing to see the deftness with which this is accomplished. The Needles are laid down before the "header" a mixed msss, out of which it would seem very difficult to elicit order; but in a twinkling the mass is cleft in twain, so to speak, all those with heads one way being put to one side, and those with the points the same way the other. It is very easy then to lay them all one way.

The succeeding process is the drilling of the eyes. By it the eye is made perfectly smooth, and the sharp edge rubbed down, so as to lessen the risk of the thread being cut when the Needle is used for sewing. The Needles, after coming here, are first what is called "*blued.*" This means that before being *drilled,* they must, to a certain extent, be heated. This having been accomplished, they pass to the drilling-room, where we see a number of men and boys at work, seated at a table. The drill is a piece of steel, between three and four inches long, and works horizontally. Taking a few of the Needles between the finger and thumb of his left hand, the workman spreads them out with the eyes uppermost, and brings the eye of each in turn under the drill. A skilful movement of the hand brings the opposite side to be submitted to the same process, and thus the drilling is accomplished.

Recently a very simple but ingenious machine has been

invented to do this part of the work. It is by Mr Wm. Heath, of Redditch. His plan is to keep the Needles stationary, and to cause the corrugated wire on which they are threaded to revolve inside the eye of the Needle, fulfilling, in fact, the functions of a circular file. This is accomplished by a treadle movement, the Needles being threaded on the wire, and held firmly in the hand of the operator during its revolution. By this simple process such a polish is given to the eye of the Needles as could be attained in no other way, and much time and labour are saved.

Of course there is, in spite of all care, a proportion of broken and imperfect Needles among these large bundles, and there are a series of processes by which these defects, at one or other of the later stages, are cleverly detected. First, we see a woman with a little drawer-like table in front of her, quickly rolling over and over with her finger a single stratum of Needles on the slab before her. She is what is technically called "*picking for crooks*"—the crooked Needle at once betraying itself when turned round on its own axis by demanding more room than its more normal neighbours. These offending members are quickly thrown out, whilst any other little defect, such as slight spot, or the least unevenness that may be noticed, determines the descent of the Needle that bears it to the category of an inferior quality. Then they are what is called *handed*, by which all that are either too long or too short are thrown out; and again they are picked for broken points and broken eyes—a thing which the girls employed



In the Bright Room.

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in this work accomplish with no little dispatch; the trained eye quickly recognising the peccant Needles, when some thousands have been tied together in a small bundle by a string round the middle of them, by these marks — the broken points being white and shining, and the broken heads, on the other hand, darker than the rest. The faulty ones are picked out by catching them in the eye of a Needle, and thrown aside. The Needles which, in spite of all scrutiny, had been thrown out as crooked, are taken to the "hard-straighteners," who through the deftest manipulation by blows of a small hammer bring them quite straight. The dispatch, unerring exactitude, and skill shown in this section of the work also greatly impressed us.

In the next room to which we are conducted we see a number of little wheels in two lines, fixed near the roof, revolving with great rapidity. The wheels are, of course, wrought by steam, through mill-bands connected with the engine-room below. This is called "the Bright Room," in which the final "grinding" and "polishing" are done. The "grinder" taking in both hands a number of Needles, deftly applies them to the quickly revolving stone in front of him, and thus grinds down any little roughness on the head or the point of the Needle; while the "polishers" in the Bright Room, by bringing every part of the Needles over a wheel of wood coated by a roll of buff leather touched with polishing paste and moving as swiftly as the other, gives to them a very clear and brilliant polish. The dexterity shown in these branches is truly astonishing.

Then, as a last touch, the Needles are rubbed between chamois leather, to remove any stains or marks that may have been left by the hands of the former workers, and the Needle is now ready for the *packing*, in which department also there is a vast deal of care, deftness, and system, Messrs S. Thomas and Sons having a number of beautiful machines for cutting and folding up to the exact size the little coloured papers with which ladies are so familiar. So expert do the women become by constant practice in papering and counting that some of them can count and paper three thousand Needles in an hour.

One word may perhaps be allowed us on the truly admirable condition of the Messrs Thomas' workshops. They are capacious, well-lighted, well-ventilated, and the healthy and happy looks of the workers—especially of the boy's and girls—suffice to prove that the employers here have, in their rebuilding, been very much alive to the conditions of health, as they have been in other ways careful for the welfare of those in their service.

We have followed only the regular stream of ordinary manufacture at the British Needle-mills; for space would fail us to tell of the exceptional, but always interesting pieces of work which vary the ordinary out-turn. We saw sail-making Needles of most admirable temper and gigantic size, as well as packing Needles, like small bayonets, besides other exceptional "makes," either finished or in course of manufacture; for it would seem as though the machinery were here almost as adaptive as the elephant's trunk, equally capable of manipulating what is hardly

visible or what is ponderous in weight. The manufacture of fish-hooks, which forms a considerable item in the work done here, might of itself furnish material for a longer article than the present, though in much the making of the fish-hook is similar to that of the Needle, passing through about as many stages. When we inform our readers that something like two hundred millions of the *best* Needles are annually made at the British Needle-mills, besides a large proportion of a second quality, and also several millions of Needles of exceptional form and size, varying from the smallest glove-needles, almost as thin as a hair and hardly an inch long, to the gigantic sail and packing implements we have referred to above, some faint notion can perhaps be formed of the inconceivable number of Needles which must year by year be manufactured in the British Islands, while the industry is now also very large in France and Germany and in America. In the year 1876, the following were the numbers given as the turn-out of the leading Needle-factories of America :—

Excelsior Needle Co., 4,188,549 ; National Needle Co., 3,781,000 ; Chas. Howard & Co., 2,591,052 ; Waterbury Needle Co., 1,734,000 ; Domestic Needle Works, 1,665,344 ; New York Needle Co., 953,628 ; Smith Bros. and Co., 972,484 ; Boston Needle Co., 659,618 ; Foster, Whitten & Co. (Whitten & Lascell), 600,741 ; Jerald and Lawton, 416,451 ; S. E. Currier, 308,350. Total, 17,860,917.

THE SEWING MACHINE.

The reader will, no doubt, be astonished to learn that the little instrument which now attracts so much attention, and has been introduced into so many homes, has been in use in England since November, 1846, at which time it was purchased of the inventor, a poor New York mechanic, by Mr Thomas, of Cheapside, for the sum of £250. The history of Elias Howe, who in "poverty, hunger, and dirt," laboured in his garret in Cambridgeport, Massachusetts, to perfect this machine, destined to settle a social problem which for years had been the despair of philanthropists, is perhaps one of the most instructive, and we may also say the most encouraging, we can remember in the history of inventors. From the moment he produced his first machine and demonstrated its availability by sewing a suit of clothes with it before the workmen in the Quincy Hall Clothing Factory, Boston, in July, 1845, his difficulties only seemed to increase. It is almost incredible, but it only illustrates the peculiar contradictions that lie in national as in individual character, that the Americans,

who are so eager after labour-saving machinery, were very slow to adopt the new invention. Howe could get no aid from his countrymen, and had to drink the bitter cup served up to inventors.

Even his claim to the origination of the Sewing Machine has been disputed or disparaged, but he is entitled to the credit of having invented the first automatic machine using two threads. These threads are interlocked very much as the mail bag used to be fastened, a loop of the upper thread being thrust through the fabric by the needle, through which loop an under thread was carried by a shuttle, and the stiches, being drawn tight, formed a seam. This he effected by combining three old and well-known devices, namely, the surgeon's or sail-maker's needle, with the eye in the point; the weaver's shutttle; and a bar moved by a ratchet, or the old saw-mill feed. For these three in combination he was granted his patent, and not for a needle with the eye in the point, as generally supposed; and the courts afterwards held that the invention consisted of these three elements used in combination to effect a new purpose. Two of these elements, the needle and shuttle, had here been reduced to a practical form, but the invention failed for want of practical application of the third element, not less essential than the other two, which was the feed. Howe's "baster-plate feed," was the bar or plate with projecting points, upon which the cloth was suspended. The plate was fed forward at each stitch by a ratchet-wheel. A seam having been sewed the length of the plate, the cloth was removed, the bar run back, the

cloth again suspended, and another length sewed. Besides the awkwardness and delay of frequently attaching and removing the cloth, a seam could only be sewed in a given direction, and when seams of curvature were to be sewed, the bar had to be altered. For this reason Howe's invention needed to be supplemented.

So, at all events, his countrymen thought, leaving him abundant time to meditate and to improve his machine, while, alas! he had to fight with starvation, which was a drawback. He had at length to make over half the patent to a friend for food and lodging afforded him while he was working at it, and at last, finding no one in America willing to use it, he determined to cross the Atlantic. Upon his arrival in London he was compelled by his abject poverty to part with the other moiety to the English capitalist for the sum we have mentioned. Mr Thomas, the purchaser, induced him to remain in his service on a small stipend to adapt the machine for stay-making, the work he required to get done. This poor Howe was obliged to do, but his future seemed even more desperate here than at home; he was often in want of food, and had to pawn his clothes to obtain the necessaries of life. At last he determined to leave what then appeared to him our inhospitable shores. His hopes of success being destroyed, he sailed again for America, and landed in New York in April, 1849.

Other inventors, he found, had briskly set to work to improve on his invention; but had only done so much as to make a show of protecting sham patents to ignore his

claims. Among the earliest of these were Messrs Morey and Johnson, who produced a machine which constructed the tambour stitch. In this machine the material was clamped between two boxes, which were fed forward by a ratchet-wheel similar to Howe's. These boxes move forward in exactly the same way as Howe's single bar, and had to be replaced at the end of the seam. Inasmuch as curved seams could not be accomplished on this machine, it could scarcely be called an improvement.

The next improver was Mr. Batchelder, who, in the year 1848, invented a machine which made the chain-stitch, and contained a very decided step in the way of improvement, by dispensing with the device of a ratchet-moved bar, and substituting a wheel with points projecting from its circumference. The points penetrated the cloth and carried it to the needle, and enabled the machine to feed continuously. But as the points penetrated the cloth it could not be turned, and only straight seams could be sewed. It was otherwise defective, in touching and supporting the cloth only at the points where they came in contact. This feed he afterwards adapted more to practical use by using two cylinders, over which ran a belt with points in it, thus forming a sort of table, upon which the material rested, and was fed forward to the needle. The Patent Office recognised Mr Batchelder's claim as covering an arrangement of a continuous feeding device, and this patent was twice extended—once by the Commissioner of Patents, and afterwards, in 1870, by an Act of Congress, and is the patent which expired on May 8, 1877.

It will be observed that up to this date all the Sewing Machines invented were crude and defective, and were chiefly regarded as curious pieces of mechanism, not being in practical use either for manufacturing or other purposes.

In the year 1849 Mr Allen B. Wilson invented a Sewing Machine, and, it is said, without ever having heard of or seen any sewing mechanism; another illustration, if this be true, of the saying that sometimes a certain idea may be said to be in the air, and to affect many persons in different places. This was the first really practical machine, making a lock-stitch and combining all the necessary elements. It had a double-pointed shuttle, and a needle similar to Howe's, worked in a like manner by a vibrating arm, and had the first feeding device which enabled the operator to guide the work in any direction at will. This invention was patented in 1850, and contained the third and last element necessary to produce a complete Sewing Machine—namely, a practical feed. This feeding device, since known as the Wilson two-motion rough-surface feed, consisted of a bar having teeth or points inclining forward, together with a smooth plate and spring above, which pressed the material upon the rough surface without being attached to it. As the bar was thrown forward the teeth engaged the cloth and moved it forward the length of a stitch and then retreated. By this device a continuous feed was secured, with which seams of any degree of curvature or angle could be sewed. Mr. Wilson afterwards improved this invention by an arrangement which allows

the teeth to drop at a certain point, retreat, and then again engage the cloth to carry it forward. This is the celebrated four-motion feed, which is now found in all Sewing Machines, and constitutes a necessary part of their mechanism.

In the year 1849 the list of Sewing Machine inventors was swollen by Messrs. Lerow and Blodgett, who invented the rotary shuttle machine, with a wheel feed like Batchelder's. The machine. however, never could be used practically until the application of Wilson's rough-surface feed. Other difficulties, such as are inherent in rotary shuttle machines, and have not yet been surmounted, finally caused the abandonment of the Lerow and Blodgett machine.

Next came Mr Isaac M. Singer, who, in 1850, invented the machine since widely known as the Singer Machine, substituting a straight needle for the Howe curved needle, using the Howe shuttle and the Lerow and Blodgett wheel feed, with Wilson's rough surface. Singer also applied a rotary shaft for driving the needle instead of the vibrating needle-arm. These, together with other improvements, were patented in 1851, and made a practical machine.

The years 1851 and 1852 witnessed further improvements in sewing mechanism, for, on August 12th of the former, Mr. A. B. Wilson patented his rotary hook, further improvements of which were patented in June following. The last patent is for the present Wheeler and Wilson Machine, containing the rotary hook and the four-motion feed.

It was about this date, 1854, that Mr. Wm. O. Grover invented and patented what is known as the Grover and Baker Machine, which resembled other machines except in one material point—it made a double-thread chain or tambour stitch.

About this time the Sewing Machine business began to assume a practical business shape. The firm of I. M. Singer & Co. had been formed to manufacture Singer's Machine; the Grover and Baker Company to manufacture Grover's; and Wheeler and Wilson Company to make Wilson's. These three companies began at once an active competition, introducing their machines for manufacturing purposes only, as it was at that time supposed that the business would be limited to that branch of sewing.

During all this time Mr. Howe had done nothing whatever with his invention. It was hardly known outside of the Patent Office. But now that three different concerns were manufacturing machines, and pushing their goods vigorously before the public, with whom a ready market was found, he awoke from his lethargy, and discovered that all three of the machines contained elements which were found in his original invention. Under the able advice of his counsel, Joel Giles, Esq., he was not long in bringing his claims for infringement to the attention of the companies.

Suit was first brought against parties in Boston, who were using the Lerow or Blodgett machine. This suit came before Judge Sprague in 1852, and resulted in a verdict for Mr. Howe as being the first and original inventor

of an automatic Sewing Machine. He then brought a suit against parties who were using the Singer Machine. This suit was resisted until the Wheeler and Wilson Company and the Grover and Baker Company had recognised the validity of Howe's patent, and taken a licence under it. Singer and Co. had endeavoured to form a combination to resist Howe's patent, but failed. The licence fees which Howe was collecting from the Wheeler and Wilson and Grover and Baker Companies enabled him to prosecute his his suits vigorously against the Singer people. They, in turn, became aroused against their two rivals, and brought suits against them both on the Morey and Johnson patent, which they had bought and had re-issued to them from the Patent Office, claiming in the re-issue the cloth presser having a spring. The first suit was brought before Judge Betts in New York, and lasted two weeks. It resulted in a disagreement of the jury. Of course this suit made allies of the Grover and Baker and Wheeler and Wilson Companies against Singer's claims. The litigation waxed hot, and plaintiff and defendant ransacked the patent records of America and foreign countries to find points against each other. It was then that the Wilson rough-surface feed was found to be very valuable. The patent on it was re-issued in 1854, and a suit under it was brought against the Singer Company for infringement.

There were similar counter suits between Howe and these three companies, which were all set down for a hearing at the same term, before Judge Samuel Nelson, at Albany.

All the combatants in this legal fray ensconced themselves in comfortable quarters at Congress Hall, where they were within easy reach of each other. With the formidable array of legal, mechanical, and commercial talent face to face, efforts were made to effect a compromise, during the several days which preceded the trial, but without success. Upon learning this, Judge Nelson, when the case was called, in the kindest language expressed to counsel his regret that a plan of settlement had not been agreed upon, and informed them that he should adjourn the Court to another day, so that the interested parties might talk their differences over and come to an understanding, if possible. After the Court adjourned, another conference was held, but resulted in another failure, and any settlement outside the Court was despaired of.

On the evening of the day upon which the last attempt at compromise was made an accidental meeting of the interested parties took place in the rooms of Singer and his counsel. A desultory talk followed, in which it became apparent that both sides were willing to make concessions. Mr Charles Keller, one of Singer's counsel, who was also one of the most earnest advocates of compromise, closely followed the discussion, and wherever he found a point of agreement, or where a concession would be made, he noted it down. The discussion was prolonged through the entire night; the whole range of the subject was viewed from every standpoint; point after point was conceded on both sides, and, as the rising sun streamed through the hotel windows, Mr Keller was writing the last clause of that

famous compact which gave birth to the Sewing Machine Combination. It was quadruplicated, witnessed, and signed before noon on the same day, October 24th, 1856, and a few hours afterwards, having dined together with Judge Nelson, the entire party left by the train for New York.

After the formation of the combination, numbers of infringers came upon the field with cheap and imperfect machines. Suits were pressed, and large sums of money, far exceeding the amount of royalties, were used in the suppression and in the protection of licensees. On the other hand, many licences were issued, for it should be borne in mind that the combination agreement expressly stipulated that all meritorious inventors should be granted licences, that the public might reap the full benefit of future improvements. This provision was demanded by Mr Howe, whose field of royalties it widened.

The Sewing Machine trade had now been placed on a firm basis, and business went on smoothly. Up to 1854 sales were almost entirely confined to manufacturers, but at this time the Wheeler and Wilson Company first conceived the idea of introducing their machines into households, and for this purpose secured agents throughout England as well as France. The step met with marked success. Other manufacturers adopted the same method. Sales were at first made for cash, but a scarcity of ready money in certain districts caused the inauguration of a credit system by means of notes. This trade was fully pushed, until the people of means were supplied with machines.

The renting system was the next innovation, intended to reach the poorest class of people, who had no property in any shape, and no credit. From this sprang the instalment plan, which has of late years occasioned so much annoyance and loss to the companies, that it is a question whether it has proved profitable to those who have adopted it. This method was usually in the form of a lease, with payment of 5 dols. per month, the company reserving the right of replevin in case of failure to pay the instalments. This plan has been fruitful of abuses. A number of unprincipled second-hand dealers have taken advantage of the system to palm off their wares on the poor people, always retaking the machines, in a summary and brutal way, whenever any of the instalments fell due and were not paid.

Although the instalment plan has its evils, there is no doubt whatever that it has been of incalculable benefit to the poorer class of working women, whose condition in life it has done much to alleviate. Thousands of girls in our large towns can testify that they directly owe their elevation to happy and comfortable homes from a state of degraded poverty to the liberality of the companies, who trusted valuable Sewing Machines to their hands when they could not get credit for bread. It is noteworthy that while the inventions which supplanted the spinning-wheel and hand-loom were controlled by capitalists, who built enormous factories and monopolised profits, in the case of the Sewing Machine no one has stood between the woman and her work The net profits were hers.

Under the instalment plan, the competition in the Sewing Machine business has probably been greater than in any other branch of trade. So great has been the cost of carrying on the business that all, or nearly all, the profits have been absorbed. This has compelled the retail prices to be kept up from sheer necessity.

Mr Wilson, like some previous inventors, had at first formed a seam with the shuttle stitch. He saw early, however, the disadvantage of this mode of forming the stitch. The shuttle carrying the lower thread must be started, stopped, and sent back in the formation of each stitch, a process requiring heavy and noisy machinery, and causing great waste of power; moreover the adjustment of the lower thread presented great difficulties, and the work was likely to be soiled with oil from the shuttle rases.

These, and various other defects inherent in shuttle machines, led Mr Wilson to invent the rotating hook, for passing the upper thread round the stationary bobbin containing the lower thread, thus substituting the rotatory motion for the reciprocating motion of the shuttle. This device is of great originality and value. In Mr Wilson's later invention, too, the material to be sewed is laid and held upon a horizontal plate by a spring presser, neither attached to it nor to the feeding device, where points act on its under surface. The material being thus free to be turned while the machine is in motion, an endless seam can be sewed at any curve or angle.

The Sewing Machine is thus quite familiar to all persons nowadays. It was not, however, until the year 1860,

when Mr Thomas's patent rights expired, that the public in England became fully aware that such a Robin Goodfellow was in our land. Mr Thomas kept the instrument entirely in his own hands, granting no licences to others to use the invention, and giving no publicity to the fact of its being in use in his own trade. Some years after Howe received his £250 for that invention, Thomas paid upwards of £2000 to another person for a very simple improvement in its feed apparatus.

Since the patent became open in this country, enterprising American firms possessing patent Sewing Machines have established themselves among us. They were all, as we have seen, founded upon the principle of Howe's original instrument, and paid him a royalty; but they are by no means all equally valuable as Sewing Machines. The worst, however, is immeasurably superior in its work, and the speed with which it is performed, to the old hand-sewing. Thirty stitches a minute is the average speed a good sempstress makes: a Wheeler and Wilson machine, or one of the Howe machines, will make five hundred in the same time. It is, in fact, to the ordinary hand-sewing what the spinning-jenny was to the spinning-wheel; and it does everything that a good needlewoman can do—hem, tuck, gather, braid, and bind, with a celerity and neatness the human hand cannot approach. Manufacturers have for some time been steadily availing themselves of its use in all matters in which the old needle was used, and contrary to all anticipations on the part of the workers, they have, with one or two exceptions, been the means of

advancing wages instead of lowering them. In the shoemaking trade, for certain parts of the work, they have entirely superseded the old needle. Almost all machines, with many wonderful modifications, are adapted for what is called waxed-thread work, and nearly all shoe uppers are now sewn by them. A Sole-sewing Machine, patented by Messrs Pearson and Co., of Leeds, in 1879, is coming into general use. All the uppers of shoes and boots are now therefore done by the Sewing Machine, and before long the soles promise to be so. When upper Sewing Machines were first introduced into Northampton, twenty years ago, a thousand men in the trade struck work, and left the town rather than use them. Now, you cannot go near a cottage in the neighbourhood of the town without hearing the click of the machine, and in large factories big rooms are occupied by sewers and cutters out of uppers. In Northampton it is the custom for the workman to buy his own machine, and work at home. This home-work has an admirable effect upon the habits of the people, and a pleasanter picture of labour could not well be found than the interior of one of these Northampton cottages, in which the Sewing Machine finds employment for all the members of the family, even down to the children. One machine is calculated to give employment for four persons, in preparing the work for the final process of sewing. In Stafford, where women's shoes are made, the machine finds work for more hands than could for a long time be found —indeed the cry was everywhere for women to work these machines; and yet, when the agent for Howe's patent

went into the market-place, and, in the presence of ten thousand women, sewed before their eyes, as they had never sewn, they were ready to tear him to pieces, and did,

in fact, drum him out of the town. If he were to return, he would meet with a very different reception, for not only is there more work than there are hands for, but the pay is far better than of old. In towns, as a rule, it is not so much the fashion to find the workman working his own machine. Large capitalists supply them to their workers in large well-ventilated rooms, as different from Hood's wretched garret as light is from darkness. We inspected on one occasion a factory in which five hundred young girls were employed in shirt-making by these machines, and a greater contrast to the poet's wretched figure, with "fingers weary and worn," could not have been afforded than by these merry bright-cheeked girls. There is a dark side to every picture, however, and we are sorry to find that there is a class of masters in London, and there only, who, totally regardless of this new means of bettering the condition of their needle-women, have adopted measures which defeat its value to them, and tend to grind them to the earth as of old. The great ready-made clothiers, instead of employing women in factories under their own eye, buy machines and let them out to *middlemen;* these again employ the women, and deprive them of all the advantages of the invention. This abominable employment of middlemen is only resorted to by three or four well-known firms, but their example will do an enormous amount of damage if they cannot be persuaded to work like other manufacturers.

One of the problems on which mechanicians have of late years been exercising themselves, is to find a fit

motive power to enable home-workers to dispense with the treadle movement, and thus completely free them from an effort which must often tend to distract them from attention to the needle. Large machines in manufactories have for many years been driven by connection with a steam shaft, leaving to each worker complete control of connection and detachment of her particular machine; but it is only recently that the thing has been aimed at for single machines. In the beginning of 1878 we heard that a Vienna mechanician had attained the desired end by means of springs strong enough to keep an ordinary-sized machine in motion for hours. We learned that this was to be realised by a system of cogged wheels, arranged underneath the surface of the table on which the machine is fixed, and that it is easily wound up by the handle at the side of the spring, so that the velocity could be determined by the worker. But this has not come into general use with us, whatever may have occurred in Germany. A year later the "Empress Water Motor" was brought out, the supply being conducted to it by an India-rubber jet—an invention that promised great practical benefit. As yet, however, we are not aware that its adoption has been very wide here, though in the United States it is largely used. One recommendation was that it would work not only the Sewing Machine, but, with equal facility, the knife-cleaner, the meat-chopper, the coffee-mill, the amateur's lathe, and even the washing-machine—a kind of good genius, or Troll of the household, ready always and faithful to perform.

In the beginning of 1878, an ingenious gentleman patented an invention by which electricity was used as a motive power for the purpose before us. It was claimed for the beautiful little engine he produced that it could be put in any place or position without in any way impairing its usefulness. It might be attached to the smallest Sewing Machine, and do the work of the stoutest feet and limbs, at an insignificant cost. When attached to a Sewing Machine it does not interfere with the treadle or foot-power, but enables the operator to make use of either, without his being in any way inconvenienced. The battery can be placed in a cellar, or in any room or position desired, from whence two wires convey the electric current to the motor. By touching the switch the machine may be put in motion, or instantaneously stopped, and the speed regulated at will. But we are not aware that this convenient contrivance has yet found a general acceptance amongst housewives.

This application of electricity does indeed make us think of the Trolls or lubber-dwarfs of Scandinavian folk-lore—the willing and serviceable slaves who, by night and day, did their silent service, and sought no rest or material reward. The figure recalls to us some admirable words of the great and philanthropic Horace Greeley, which we must crave leave to quote:

"Women can no longer be sent to the loom and the wheel, as in days when the garments of the household were woven and spun by the loom and spindle at home, for our spinning-jennies have taken the labour out of their hands

years ago. New modes of labour opened with the opening resources of the country. Women found more leisure for mental improvement, with the disuse of the spindle and loom. Still there remained her servitude to the needle; side-stitch, hem, fell, 'seam and gusset, and band,' 'band, and gusset, and seam,' from matins to vespers; wife, maid, and servant; lady and working-woman—all of the feminine class, were to be occupied for ever and for ever, to all eternity in futurity, to gather breadths of linen for a household.

"As a last relief came the Sewing Machine. We saw in it another step in the emancipation of women. We saw that she would be exonerated from much that was monotonous, wearisome, and belittling in her lot. We saw that the machine would save numberless eyes, myriads of nerves, and that households must, through this invention, become more intelligent, more genial, and altogether help a better development in society. The solitary needle will pass into disuse. The Sewing Machine does all that was fatiguing and wearisome in the manufacture of garments, and now women have taken another step towards freedom. It will force the industry of women into a thousand new channels, and emancipate them from the cramped posture and slow starvation of needlework.

"Ultimately, nearly every comfortable household will have its Sewing Machine. There are seamstresses in our city who first borrowed the money to buy one, and now own two or three, having other seamstresses to work those for which their own hands do not suffice. The time is rapidly

approaching when at least three-fourths of the sewing in our city will be done by machines. Let us hope that the blessings of the industrial progress which is opening a new era upon mankind, will be enjoyed by the many. Woman's brain will soon do its office in the world, as she has opportunities to use it. The thraldom of the needle has been her greatest trial in civilised society. Her busy fingers left her brain free for all its worst uses. She has had about her the graces of quietude, of seclusion, and gentle culture which has always made a woman at her needle suggest to our brothers the image of domestic content, love in a cottage, and other and pretty false dreamings.

"We have had opportunities to know, and we assert that a woman confined for more than two or three hours at her needle daily, is always a discontented woman, however much she may try to disguise the fact. The minute attention required, the strain upon the eyes, the confined attitude—all wear upon the nerves, and impel the occupied brain to morbid strains of action. Women of cheerful temperament instinctively seek each other, when obliged to sit long at the needle. In country places you will see them with shawl on head and basket in hand, wending their way to each other's houses, in order to have a friendly gossip while advancing the comforts of the household. Men often ridicule this propensity in women, and those of a sullen temper put a stop to it in some way or other. But it is an instinctive wisdom worthy of respect, a harmless protection to the nerves. Women who are obliged to use the needle much alone invariably grow morbid, lose

both health and spirits. For ourselves, when we have been compelled to this necessity, we have studied some book, at intervals, as a hindrance to excessive mental activity. The needle will soon be consigned to oblivion; like the wheel and the loom, and the knitting needle. The working-woman will now work fewer hours, and receive greater remuneration. People will have more work done, will dress better, change oftener, and altogether grow better looking, as well as nicer looking. The more work can be done, the cheaper it can be done by means of machinery, *the greater will be the demand.* Men and women will disdain the soupçon of a nice worn garment, and gradually we shall become a nation without spot or blemish. Fresh lavendered linen would so create the demand for civic cleanliness and moral purity that golden-haired children, with muslin robes, and dainty women, redolent of roses and snowy lawn, white-jacketed men, with sprigs of flowers in the button-hole, would tread Broadway, garnished and watered before the sun, with the same impunity they would walk a saloon, and Diogenes will come out with his lantern, not in pursuit of an honest man, but the great anomaly—a rogue."

One of the most valuable of the many adjuncts made to the Sewing Machine during the last few years is the darning attachment, the best form of which is perhaps that of Mr Harrison. It is a very simple and yet a very efficient contrivance, capable of doing a host of things which cannot be accomplished by ordinary stitching, such as mending holes in table and bed linen, in underclothing,

handkerchiefs, and hosiery, in fact every sort of article that has a tear or a darn in it. The main element in the invention is simply a spiral spring which can be attached to any Sewing Machine needle; the needle thread being passed inward through the spiral spring down to and through the eye of the needle; and a special form of presser called into use. The directions for use are very simple:—Place the goods that are to be darned under the needle and proceed to darn, moving the goods with the hands in any direction required. Bear in mind that you have "turned the feed off" the machine, and that you must move the cloth back and forward by hand until you have run lines of sewing one way across the hole to and from you; then you must move the cloth from right to left until you run lines of sewing across the whole that way. Be careful that you do not pucker the material you are darning. Keep your hands on the cloth close to the needle when you are moving it backwards and forwards. The attachment performs the function of a presser foot, and the darning consists of lines and cross-lines of sewing.

The Sewing Machine has even been adapted to the sewing on of soles, Messrs Pearson and Co., of Leeds, having patented a beautiful instrument for this purpose. The principal working parts are carried in a frame, or head-casting, supported on the top of a tripod stand. On the shaft of the machine is fixed an eccentric giving the requisite motion to the needle; this motion is transmitted through a beam, or lever pivoted to a sliding bar; attached to this bar is a projection connected to the presser foot in

such a manner that the thickness of the sole acts directly to control the stroke of the needle, thus making it automatic in its action, and varying the stroke of the needle as the sole varies in thickness.

To the presser foot bar is connected a feeding instrument, operated by a cam, to move the boot forwards the distance of a stitch. The foot and feeder are connected together, so that whilst both are free to perform their respective functions of feeding the boot and holding it firm, when required they may be lifted together by a hand-lever to allow of the boot being placed on the horn of the machine. The mechanisms imparting the various motions are very simple, positive in their actions, and not at all liable to derangement.

The inclined horn of the machine revolves in a substantial socket (which is capable of adjustment to allow of its being set in line of needle) in an axial line of the needle. The top of the horn terminates in a hardened steel tip, the extreme point of which is small enough to allow of its entering freely into the thin-toed boots. Within this tip, quite at the end, works the looper. In the centre of the end of the horn there is a hole, down which descends the needle for the purpose of receiving the thread, which is laid into the hook of the needle by the looper at each revolution of the machine. Motion is imparted to the looper by a very simple connection of levers and rods from a crank pin on the end of a machine shaft.

The thread spool or bobbin, containing 1lb. of hard-waxed thread, is placed on a tension devise at the base of

the horn; the thread passes from this bobbin round a small pulley (controlled by a spring to take up the slack of the thread at each stitch), up and within the inclined arm of the horn and through the looper. The wax on the thread is softened sufficiently for working by the heat of a neatly arranged, smokeless, gas heater within the horn, and well out of the way of the upper of the boot. The horn may be heated in ten minutes; the supply of gas is perfectly under command by a cock or tap close to the hand of the operator. Where gas is not available, a small spirit lamp may be used.

The machine runs very easily and smoothly, and all its principal wearing parts are made of steel.

The new metal "phosphor-bronze" is introduced in several parts where great toughness is required.

Arrangements are being made that all the principal wearing parts may be produced in duplicate, so that should any accident cause a breakage, a new part may be obtained (at a low price) to replace it at once.

The channelling machine, thread-waxer, winding-machine, steam power shaft, &c., are equally well and carefully made, and are charged separately from the price of the machine, so that a manufacturer requiring two or more machines may have one or more sets.

The machine is protected by two English patents, and is also patented on the Continent, and it is placed in the market at the moderate price of £80 per machine, without royalty.

A word or two more on the great social benefit of the

invention or series of inventions. The machine at one blow emancipates the sempstress from the fatiguing position, and the contracted chest, that oppressed her of old. There can be no doubt that the needle killed far more than the sword ever did. And we trust we may hear no more of young girls done to death by the excessive fatigue caused to poor milliners during the London season.

What the committees of the House of Lords have failed to accomplish, the American machine will inevitably bring about. Although human muscles break down under the inhuman stress put upon them, the iron fingers of the Sewing Machine are all-enduring. We are told that whilst a hand-made silk dress occupies eight hours and twenty-seven minutes in making, the machine-made dress only occupies one hour and thirteen minutes; it is true that lace cannot be sewn on by the machine, therefore the trimmings would still have to be sewn by hand. But the main part of the work can now be done in an incredibly short time, and there can be no longer need of poor girls sitting up the whole of the night for six nights in succession in order that "my lady" may flutter for an hour or so in the ball-room.

The only trade that has not to any extent adopted the machine in England is that of the harness-maker. Through the saddlers' windows we still see sturdy men slowly stitching away like so many women; and on inquiry we find it asserted that the machine cannot produce sufficiently strong work. Now that waxed-thread machines are common this is a peculiar excuse. All the harness

used in the United States is machine-made, even that employed in the artillery, consequently it cannot be said that it will not stand wear and tear. Saddlers and harness-makers are, as a trade, conservative, and obtain very high prices for their present work, and what keeps the machine at arm's length is the fear of strikes and the lowering of prices; this, however, is beginning to right itself.

The cry on every hand is still for more educated labour. All the unemployed sempstresses in London would be engaged in a week if they but thoroughly knew the manner of using the Sewing Machine. Here is an admirable opening for philanthropic persons bent upon ameliorating their hitherto forlorn condition. If a few of those individuals who are going about seeking those to whom they may do good were to hire a large room, obtain the loan of a score of machines—they would be lent gratuitously by the different patentees, we have reason to know—and employ half-a-dozen instructresses in their use for all poor women applying, they would be aiming a great blow at the "social evil," and doing more for the surplus female labour of this country than all that has been done heretofore. Ladies who have themselves acquired a general notion of the working of the machine could impart the knowledge to their poorer sisters. Congregations, we believe, could effect great changes for the better by raising collections or subscriptions to aid a number of struggling needle-women to get a machine of their own. Thousands of women are starving for want of work, on the other hand hundreds of masters are crying

out for workers—all that is wanted is the little prelimin education with the machine which neither the poor wo nor the masters can afford to give; and this instruct can easily be acquired by active intelligent women in short period of a week. We have shown how this may be afforded, and, we may add that the machine one of the largest patentees have been offered free charge, and, we regret to say, declined. The thing is be done, however, and we only desire to make it wid known, sure that help is at hand.

The blind have shown a peculiar aptitude for the wo We once saw some very beautiful sewing executed by so of these afflicted persons at the office of the Ho Teaching Society for the Blind, in New Oxford Stre The sense of touch is so nice in those who have lost th eyesight that really they see with their fingers as well others do with their eyes: at all events, the work do by those who are learning at the Society's rooms, wh they have several machines, seemed quite as good as th done in the ordinary way. There are upwards of 30,0 blind persons in the United Kingdom: of these one-h are women, of whom hitherto but a small number ha been able to earn anything towards their own suppor indeed, the same may be said of the men. The Sewi Machine is now open to most of these, and they will able to command far better wages than they could basket-making, or mat-making, which heretofore form their principal means of employment.

With regard to Sewing Machines themselves, we may

permitted to say a few words. They differ in character like all other patented machines. There are some which make what is termed the chain-stitch; they are useful for simpler work, such as hemming. There are others which make what is termed the double or treble chain-stitch; and though it is sometimes objected to these that they consume a great deal of superfluous cotton, and make an ugly ridge on the under side of the sewing, they are well adapted for some sorts of work—for instance, in cases where there is a possibility of the work being taken down to remake up. The lock-stitch is by far the most permanent and valuable method of sewing, as the lock of the thread takes place in the substance of the material itself. This makes it invaluable in shoe-making. These machines follow the original patent of Howe. The Wheeler and Wilson Machine, and also the Singer, are well fitted for home use; but most machines now possess the lock-stitch —the Florence, the Excelsior, the Grover and Baker, the Wanzer, and the Alexandra. Each of these besides has merits peculiar to itself, which purchasers can learn by reference to the catalogues. It is very singular that there is no good English Sewing Machine in the market. An Englishman, Mr Fisher, of Nottingham, did indeed construct a machine for embroidering as early as December, 1844, before Howe's patent was granted; and this machine actually contained many of the movements of the Sewing Machine. The inventor, however, did not intend it for that purpose, and the patent was allowed to drop. But it was within an ace of doing the work Howe a year afterwards

accomplished, and it is an instance of how near a man may come to the most valuable invention and miss it.

In America the dearness of skilled labour, and the liberal terms on which the inventor Howe granted his licences to other patentees to use his movements of the machine, have resulted in an enormous number of them being used. In the United States large capital is employed in the manufacture of machines. The Wheeler and Wilson Company have a manufactory at Bridgeport, Connecticut, which employs thousands of men, and an extraordinary number of automatic or self-acting machines, for the construction of the different parts of their Sewing Machine, like our Government manufactory at Enfield. The different parts, like those of the famous national rifle, are made to gauge to a thousandth part of an inch; therefore they are all interchangeable, and if any part of one of these machines is broken, it can be instantly replaced by a duplicate piece. There are also the large establishments of the Howe Company and Grover and Baker. These manufactories are capable of turning out upwards of three thousand machines weekly. The value of the sewing done by these machines in the United States has been proved to be £205,000,000. We in England have not availed ourselves of its labours to a fourth part of this amount, but it must be remembered that we have only begun to use them since the patent rights of Mr Thomas in the Howe machine expired in 1860, whilst our trans-Atlantic brethren have been employing them since the year 1856. In another ten years we expect that the ordinary needle will become a curiosity, for

the Sewing Machine is not only taking possession of our manufactories, and is there allying itself to steam power, but it is gradually creeping into our work-rooms at home. Indeed, we may hope ultimately to find our mothers and sisters, emancipated at once from worn fingers and bitter drudgery, enabled to employ more of their time in the art of making home intellectual and happy.

AT CHATHAM.

"PEACE hath its victories as well as war." Very true; but a sight of Chatham, however cursory, serves to show that even the victories of peace very soon come to subserve the ends of warfare. In these days of complicated relationships and mixed motives, and religion absorbed in poetry, and materialism and general reliance on "Tendency," it may well occur to any one, as a peculiar triumph and illustration that Peace and War do thus come together, and shake hands, and mutually embrace each other, at the beck of science. At Chatham, at all events, everything seems to take a tone from the presence of the redcoats and the bluejackets. A walk is not possible in any direction without reminders of the possibility of "mutual carnage." The garrison is some 4,000 strong, the Line, the Cavalry, the Marines, and the Engineers being represented. But military efficiency depends, after all, on manufacture—on the industrial application of certain arts. Cannon must be cast, ships must be built and maintained in good condition; and here the latter work is gone through to purpose

All seems to aid in it, all to depend upon it. The dockyards of Chatham, which are now, since recent additions, the largest in this country, or, indeed, in the world, cover about 150 acres of ground. The dockyards are the centre of Chatham influence and importance; its great convict prison is tributary to these, the bulk of its 1,700 inmates being engaged on works subsidiary to military ends—the new basin, which covers some thirty-five acres, completing a line of docks opening out from the Medway at one point and opening into it at another. The ships of the navy, in passing through this line of basins, are renovated with the utmost despatch, economy, and convenience. If it is needful to maintain our supremacy by such means, the whole look of things certainly gives the impression that practical steps are being taken to secure it. The dockyards at Chatham are certainly a most interesting and suggestive sight. Let us step inside this gate a moment and look through.

First, turning to the left, we come on whole streets of warehouses several stories high, devoted to the storing of oils, tars, and other commodities always found in the precincts of a naval arsenal. Passing this, we come on a ropery, extending in length to some 170 fathoms, where we see the process of manufacture from the very first. Here at one side as we enter the door are little lads winding on big reels the yellow jute which, now used instead of woollen yarn, gives the Government mark to the cables. That coloured strand is a very clever detective—a grave warning to all marine store-dealers and doubtful receivers of property. The Government follows up its own goods

with penalties so special and severe that few would make the venture of acquiring its property in an easy way, Before us, are men engaged in adjusting the large bobbins in spindle-like catches on the roof, and then drawing down the threads and hooking them with the greatest order and despatch through multitudinous eyeholes in door-like pieces of wood set up from floor to roof at equal distances. These threads are then attached to a traversing engine, by which they are twisted with great speed. This engine when it reaches the upper end is attached to another line, twisting a still stronger strand, and so is kept continually coming and going. Some of the ropes made here are of tremendous size—the strands are themselves ropes, and come out clean, smooth, and perfect at once from the machine.

From this peculiar expedient of the coloured strand twisted in the ropes Goethe has drawn one of his finest images. "We hear of a curious contrivance in the English naval service," he says. "All the ropes that are used in the Royal Navy, from the strongest to the weakest, are twisted in such a way that a red thread runs through them from end to end (*ein rother Faden durch das Ganze durchgeht*), and this cannot be extracted without untwisting the whole, and by it the smallest pieces may be recognised as belonging to the crown. Just so is there drawn through Ottilies' diary (in the Elective Affinities, or "Wahlwerwandschaften,") a thread of attachment and affection which connects it altogether and characterises the whole."

Turning up the street again, we see that the middle

space is occupied by great masses of anchors and iron cables laid out, some of them as useless, others to be repaired and repainted, which process is going on in a long shed opposite. Here are great piles of old ropes and sails, to be sold, we suppose; and turning round the corner on to the wharf, we see before us literally acres of new anchors, white painted, of all sizes, classified and ticketed. Some tower up as high as the roof of an ordinary cottage, others are not larger than boat anchors.

The picturesque and familiar old anchor that stood in such good stead as a symbol, like many other things, is now superseded, and will soon be seen no more. Such a thing, indeed, would seem out of place on the great iron-ships now being built, so completely encased in iron that there is no room for beauty of line or curve. As the thickness of the encasing armour has increased, so beauty of form has more and more disappeared. The *Warrior*, the first armour-plated vessel built, had a thickness of iron of some six inches; the last one has nearly twenty inches; and no sooner is a ship launched that is declared invulnerable than another engine of destruction is produced to triumph over this. Thus, there is no fear that science will for a long time cease to temper between the victories of peace and the victories of war. The famous anchor now is the "Trotman Anchor"—a very massive engine in itself, sometimes weighing as much as six or seven tons, and costing from £250 to £400.

Next we pass to the mast-houses, where are stored the huge pieces of timber that shall by-and-by be formed into

masts for the ships of the navy, recalling Milton's famous line:—

"Tall as the mast of some great ammiral."

The mainmasts of first-rate ships are more than 200 feet in height, and are made of many separate pieces tightly bound together. In another store were kept varieties of all kinds of boats, gigs, and launches, classified and ready for immediate service.

Here in the warehouses are stock of blocks of all sizes. from what might be mistaken for a big nut up to what might at a distance very well pass for a sleeping turtle. The machinery in the block department is so perfect that in a few minutes the rude unshapen wood is, before our eyes, transformed into a finished block. It is all worked by steam power, of course—saws, lathes, &c. The navy demands a large supply of blocks—a single large ship requiring as many as fifteen hundred.

As we proceed up the wharf, we come on an immense foundry, where men are engaged in moulding large plates, and beams, and next to it are several acres of furnaces. Here we see large sheets of metal rolled through a powerful engine, which is so contrived that in a few seconds it gives the thickest plate of iron the necessary curve. Nasmyth's steam-hammer—so strong as to smash great bars of iron, yet so delicate as to crack a nut without breaking the kernel—is, we see, in full work; and well may those in charge of it feel proud of the complete control they can exercise over this giant. Proceeding along the yard, we see all forms of engines at work, which slice the solid iron as

though it were but wood. Here is a large machine, which is cutting out a semicircle in the side of what seems a solid plate, half-a-foot thick, and of some four feet by six or so in surface-extent. It brings off at each stroke of the machine a shaving of iron, and is so set that it cuts exactly to the curve with steady, relentless exactitude. Next to it, another machine eyelet-holes the iron for the bolts with such speed that half-a-dozen men can hardly turn round the plate quickly enough. Here, in this shed, are iron-plates of all shapes and sizes ready to use, over there is another; before us begin what are properly the docks; and, stepping forward, we are at the stern of what promises to be one of the strongest of our iron war-ships. She is now approaching completion, and embodies the latest results, though the invention of man is so prolific in this direction that already, it seems, there are points which must wait for application to her successor. Further on are others—dock after dock, ship after ship, and from each a ceaseless noise of hammers. Here a wooden vessel is being overhauled in the hull; there another is getting in new machinery. We walk on—passing sheds where all manner of trades are carried on—to a basin in which the old and the new eras are certainly well represented. Hulks with their many-tiered look, which recall the glorious days of Nelson and the Nile, wait here to be bought and broken up; and not far off lie later ironclads and one turret ship, the Rupert, built some seven years ago. If our later war-ships are more efficient for deadly power, certainly the old hulks still have the advantage in point of picturesque

appearance. The impression we derive from the whole is that war is a most expensive game to play at, and a witness to the folly of mankind, who might be supposed ere this to have learned to settle their national quarrels in some other way than by force, when they have found means of making the individuals of which they are composed peaceably settle theirs by reference to the law.

IN A HOP-GARDEN.

THE present writer once witnessed what was to him a strange exodus. Having occasion to pass through the City of London very early on a September morning, while the dawn was only stealing dimly through the streets and the air was still keen, he was much surprised, on coming to Cheapside, to find this thoroughfare, usually quiet almost as the grave at such an hour, alive with a motley crowd. Men, women, and children, all bearing burdens — half-filled canvas sacks, big parcels done up in dirty coloured cotton handkerchiefs, some of the stronger lads even with black pots and pans slung over their shoulders, and not a few of the women with the inevitable babies—made their way quickly and with no little noise and clatter towards one point. Inquiry brought the information that they were "hoppers," bound for the early "hoppers' train," which would convey them at reduced rates for their annual country outing to the leafy lands of Kent. Such trains stop at all the stations in Kent, nearest to the Hop-fields, and in the course of a

day or two these rural districts are filled with the noise of a London crowd. Huts and tents are raised in the fields, and great barns are thrown open for them. On the first Sunday of last season, we learn that at Farleigh alone five hundred extra hands had arrived before seven in the morning. With such a peculiar influx of population, it is not surprising if the hop-pickers should get full benefit of fresh air. The fields in which their tents or barns are situated become for the time being the common room or parlour; for almost everything is done in the open air.

In imagination the writer followed these denizens of the dark courts, the back lanes, and the slums of London, and wondered whether nature in its lovelier aspects produced upon them any benignant impression. Fresh air and new surroundings—the sight of green fields and trees and flowers—he fancied, could not but in some degree soften the feelings and brace up and strengthen the physical frame; and he was fain to believe that, for the little children at all events, this change must be highly beneficial. He had heard so much of the wretched condition in which many of these people were housed on the Hop farms; of the riots, and the washing bouts, on the Sundays instead of quiet rest; of the orgies that celebrated the pay-nights, and the fighting and the vile language that accompanied them, that he had often wished to see for himself something of their industry and also of their way of life during their yearly Hegira. The opportunity for fully gratifying this wish was at length made possible to him; and now he will try to communicate to his readers something of

what he saw, and learned, and felt on his visit to the hop country.

One of the first impressions produced on him when he began to investigate the curiosities of the little village which stood as metropolis to the Kentish district in which he found himself, was the utter primitiveness of life that may be found, like some fossil in a later strata, subsisting in union with a whiff of the higher civilisation, within twenty or thirty miles of London. Finding himself under the necessity of telegraphing to a distance, he inquired for the post office, and on reaching it and opening the door, he found he had to walk through a dusty bakehouse, where two or three men, freely exposed to all comers, were busily engaged in "laying the sponge," before he could reach the desk to write out his telegram. Carillons sounded sweetly from the church tower as he passed outward, suggesting a hurried visit to the fine old structure recently restored. The inscriptions on the flat gravestones round the floor were of the quaintest, some of them recalling the days of Puritan and Cavalier, of Civil War, and Restoration. Past that inn door which soon comes into view when we emerge from the church, and where we see the pointers waiting impatiently, once dashed his Majesty's troopers, and yonder fell one of the bravest soldiers of his day, whose death is fitly chronicled on the spot. But our business is more with the present than with the past—the crops that lie ready to be reaped, rather than with the minutiæ of historical reminiscence. We enter the inn, soon to hear from the lips of hearty farmers words that

hardly sound so hearty as would seem to befit their round rubicund aspect. Their wheat is light — crop certainly much below average; the Hops generally a poor yield, if not indeed a failure, hardly worth the picking. Some fields, we hear, will not be picked this year (1879); and on ground which in happier times has yielded from twelve hundred-weight up almost to a ton, not more than a hundred-weight and a half or two hundred-weight at the most will be forthcoming. This we soon discover affects different persons in different ways. The farmer with a crop much below average will be a great loser; the farmer with a fair crop will do pretty well. For the scarcity has already raised the prices, and instead of the £3 or £4 per hundred-weight in more plenteous seasons, good Hops will bring some £12 or £16 per hundred-weight. As for the "hoppers," they, too, are serious losers by the scarcity. They are paid not by the amount of work they have in making up a bushel, or by the time spent over it; but for the bushel, however it may be made. A practised picker will clear a full bine in half the time needed for a poor one, and thus the "hoppers" have not this year had their usual harvest. Many, indeed, have gone to the Hop districts to be miserably disappointed, and to tramp back to London empty-handed and disheartened—genuine objects of sympathy.

The Hop, as our readers must be aware, is a perennial. The root having been planted in suitable soil (a rich clay which has been well prepared), it only needs now and then a dressing of rape dust, rabbits' flick, or woollen rags,

which in a short time form a rich compost for it—another apt illustration of Lord Palmerston's forcible expression that "dirt is only matter in the wrong place." "Out of cast-off old clothes comes bitter beer" would sound somewhat of an extravagance, and yet it is not quite so foundationless as are many smart sayings. Old Tusser seizes this in his "Five Hundred Good Points of Husbandry:"—

"Choose soil for the hop of the rottenest mould,
Well-doonged and well-worked as a garden-plot should;
Now dig it and leave it the sun for to burne,
And afterwards fense it to serve for that turn.

"The hop for his profit I thus do exalt,
It strengtheneth drink and it flavoureth malt;
And being well brewed, long kep it will last,
And drawing will bide if ye draw not too fast."

The Hops are planted 6 feet by 6 apart in straight lines, which gives that regularity which mainly it is that makes a Hop-garden such a beautiful sight when the plants come to leaf and flower and begin gently to wave to and fro as the wind stirs them. Sometimes, to attain an object of his own, the farmer will narrow the distance one way, and make his planting 6 by 5 feet. Three slips are usually planted triangularly on each "mound" a few inches apart, one pole serving for all. When new planted from slips, or green shoots from the old plant, the Hop yields little till the third year; and, as the preparation of the ground and the manuring are expensive, it will readily be understood that in certain conditions of tenure a farmer will rather work on with his old plants than adventure on introducing new and improved ones. But this would raise questions

on which we must not enter here. There are various kinds of Hops, some of which suit one land, and some another. One man holds by Bramble Goldings, another by Golden Grapes, a third by Jones's, and a fourth by Colgates. Of all of these there are several varieties. Experience only can arrive at the solution of which may be best for this or that land. The first two kinds named are mostly used for the finer beers—bitter beer especially; the latter two chiefly for ales and porter. There is an old saw to the effect that:—

> "Hops and turkeys, carp and beer,
> All came to England in one year."

But it is somewhat surprising to learn that the Hops were not universally welcomed when they did come. Brewers were prohibited by law from using them, as they were said to spoil the taste of the *ale;* and the word *beer* came afterwards into common use when the introduction of the Hop spread, to indicate the beverage in which Hops played a part. And it is still more odd perhaps to read that "upon the introduction of Hops in the reign of Elizabeth, the Kentish farmers, whose land was overrun with coppice, objected to their growth, by which they are now so largely benefited, because they occasioned a spoile of wood for poles."

In the reign of Edward VI. certain privileges had been granted to hop-growers, and lands were set apart for the culture of them. Since then Hops have grown in credit till now they rank as a valuable product in Belgium, France, and the United States, as well as in England.

The Hop is one of those growths which have so deeply interested Mr Darwin, on account of the peculiar manner in which they are fertilized. After the most careful observations of Mr Darwin and Sir John Lubbock, it may be accepted as settled that the hop is *anemophilous*—that is, it belongs to the class of plants the pollen of which is carried to the stigma by the wind. This means, of course, that it has male and female flowers on different plants. The hop-farmers are thus much dependent on seasons and on winds. Prior to the wonderfully laborious, patient, and exact labours of Mr Darwin, even good naturalists were inclined to credit insects with a share in the work that resulted in a well-flowered Hop-garden; and it was a very pleasing kind of fancy, but hard facts have disproved it.

In England, between sixty and seventy thousand acres are planted with Hops, and of these nearly thirty thousand are in Kent. They are heavily taxed, a tithe-charge, varying from 15s. to £1 per acre being levied on all hop-planted land. In scarcely any crop, however, does the out-turn vary more; in one year the entire crop has amounted to about seventy million pounds, while in another year it has fallen under a million and a-half. In the year 1879 it certainly fell far below even the "happy medium" between the two.

But our "hoppers" are already ranged in order, ready for work. Extended far up the field in regular line are a number (perhaps thirty) of long, barrow-like frames, though without wheels. These are called *binns,* round each of

which two or three persons are grouped, forming a party. Over the stilts are slipped the corner holds of an open canvas bag, into which the Hops fall from the hands of the picker. For every five or six binns a man is engaged to cut off the bines from the root and to pull up the poles, which are then laid one by one as required with their tops resting upon the binn, and the Hops still fixed there. The merest children are seated round the binns, all as busy as they can be, on bits of sprays cut off and tossed to them, for here the truth of the adage is vividly felt—"Many a little makes a mickle." The community is of the most mixed description. Apart from the ordinary farm-labourers' people and cottagers from the country round, the Londoners would afford a study in contrasts which it would exhaust the ingenuity of a Jacques Callot or a Rembrandt fully to represent. There is the virago of the court, blowsy, bold-faced, with hair unkempt and clothes ill put on, unabashed by new circumstances, joking loudly, and jeering the children as well as the older folks; there clearly is broken-down respectability, in the shape of a quiet, grey-haired, patient-faced widow and her daughter, who have undoubtedly seen better days; and there again are two young orphan girls, who have attached themselves to a neighbour to begin a new experience. Scarcely anywhere more vividly than in a Hop-garden in picking time must recur to a reflective mind the truth of the saying that "poverty makes men acquainted with strange bedfellows," and this with only too close an approach in many cases to a literal interpretation. Masters of arts and doctors of medicine have

through drink or misfortune, found themselves among the hop-pickers; and though one cannot but pity them, one must pity yet more those who, once in better circumstances, are there through no fault of their own. In the district where we now are, happily the "hoppers" are for the most part old "visitors," the gentlemen mainly concerned making it a point to exercise over those who come for this purpose as strict a supervision as they can, quartering them, as far as is practicable, under their eye, having first made as prudent a choice of their company as was possible. They do not trust to chance, but endeavour to engage all the help they need by letters, which makes them independent of the purely tramp community. If all hop farmers would do the same, some scenes of disorder and debauch might be avoided, and much gained at little cost. To illustrate what has been said on this head, we may here give one or two of the "hoppers'" letters of application, which are in many ways contrasts to each other. First of all comes a widow who has seen better days, and who has clearly received a fair education. She writes:—

Bow, London, *Aug.* 5, 1879.

"Please Mr —— can I have two binns this year for hop-picking? if ever so little I shall be glad to come. An early answer will much oblige,

"Yours respectfully,

"A—— H——."

Mrs A—— W—— has been less acquainted with the schoolmaster in her young days, but does not on that

account feel any the more restraint. She is guiltless of a date, and has no regard for capitals :—

"Dear sir Could you oblidge me By leting me have 1 Bin as i should very Much like To Come Down This hoping give My love To all enquiring friends Dear sir Whould you Be Kind enuf To rite and let Me know Weather you Can let Me have the same."

Mrs P——, the wife of a working man, is more precise, as she is perhaps somewhat more urgent :—

"*September* 1*st*, 1879.

"SIR,—Please to Excuse for Takeing the Liberty of droping a few more lines to you concerning the request of me Coming to your Ground hopeing sence I rote to you last I have removed from the last Address & Sir as I fully Expect an Answer you will Please send to this Address and you will Grateley oblige your Humble Servant."

C—— J—— is also dateless, but is full of good hopes :—

"SIR Will you oblige me with three bins hoping the hops are good and hoping yourself and family well I remain dear sir your humble servant,

"C—— J——."

Mrs J—— E——, who hails, as she says, from "Bromb-ley by Bow," is guiltless of grammar and spelling, but cannot, like some, be blamed for wasting words :—

"SIR Will you kindly Let me now by return of Poast when you start the hop Picking and if i can have 3 bins answer will oblige "Yours Respecfl

"J—— E——."

S—— J—— is not less precise, and has complete confidence in the impression formerly made by her on her employers :—

"*August 5th,* 1879.

SIR,—I wish to Come Hop Picking to you This year and we Want The Same as last year.

"S—— J——."

Some special dangers await the hop-picker, against which he should be on the watch—well, if he watches at the right points. Temptations to indulgence assail him at all hands; and special agencies are brought into the field. He is too often regarded as a mere receptacle for bad produce. Bad meat finds its way to him readily; and bad half-rotten fruit, which need not be sent elsewhere, and of which in such a district there is sure to be a little about that time, is sorely tempting to the Londoners, who often suffer much by it. Epidemics have sprung from indulgence in these things; and, therefore, the sanitary inspectors are called on to do their utmost to restrain "honest people" from injuring the "hoppers," in their own interest, too.

On the whole, the behaviour of the hoppers, so far as we saw it, was creditable. It would be too much to expect that a miscellaneous gathering of people, thrown suddenly into circumstances of such close association, should not now and then fall out over trifles, and speak occasionally in louder tones than are deemed quite proper in good society, and perhaps, too, use a phrase now and then more or less unfamiliar to the select. And certainly the attractions to

vice were not wanting. Drink was brought too near to them for their own peace. In each of the villages within the district—villages not containing more than two or three hundred inhabitants—there are on an average no fewer than five beershops—a supply, doubtless, not beyond the demand, else some of them would soon cease to exist, but surely quite sufficient to justify the remark we have made. Any aim at radical improvement in our English village life must not fail to face the facts that are here presented. If the country had a Permissive Bill, we can almost confidently say that this institution would not long continue to sow its poison seeds abroad in a village which needs only sobriety and providence to make it a kind of Arcadia.

But we moralise: and meanwhile the Hops are being measured as they are taken from the binns. The picker is very careful, as we see, to shake up the hops each time before the bushel measure is filled; for a very slight pressure would crush them down, and make a great difference in the result. The pay for picking is about 3d. a bushel. Quantities varying from eight to fifteen bushels are found in each binn, all which having been duly recorded, the waggon with its load moves off the field to the oast, where we must follow it.

The round structures at a certain elevation, narrowing afterwards to a point, with a sort of wooden wind-vane (as at breweries), which usually appear in pairs in Kentish or Sussex homesteads, and form very characteristic objects in the landscape, are the *oasts*—a very necessary and valuable part of the machinery for hop-produce. Hither the Hops

are conveyed direct from the fields. In the lower portion a fire is kept up of coke or charcoal, sometimes with a proportion of sulphur. This is necessary to prevent all smoke or dirt ascending such as would darken or discolour: a nice yellow tint is given by the sulphur. About a height of ten feet from the level where the fire burns there is a floor of laths, closely set to each other, the interstices being filled by a network of horsehair, so thin that, on looking down while yet the oast is clear of Hops, you can see the fire burning through it. On this floor the Hops are spread out at an equal thickness of about a foot all round, and at certain intervals they are either trodden or stirred by a big spade-shaped wooden implement in the hand of a workman, the purpose of which is to secure an equal exposure of all the contents to the heat. After ten or eleven hours they are withdrawn from the oast, now dry and crisp, and ready to be packed up tightly in large bags. The bags are passed through a round hole in the floor of the loft in the oast, fixed there by the mouth, filled by means of the big wooden spade, and the hops are then firmly trodden down. They are now ready to be sent off to the Hop market or to the brewer. In spite of the dryness, the odour peculiar to Hops is fuller and stronger than before; and the colour which they now bear is a matter of great importance in view of the markets.

When, finally, the hops have been gathered in, the hoppers are often treated to a grand supper by the farmer. This is known as the "hoppers' over," and is held in large barns. The feast generally consists of pork and salt beef,

and beer. When the eating is finished, a fiddler appears to give the signal for the dance.

In spite of all the exposure, and too often the irregularity and excess, the Londoners get great benefit from the hop-picking. It is well known, of course, that the odour of the Hop-garden is not only innocuous, but medicinal. Hop-pillows have been prescribed for patients in certain forms of fever and other diseases, and exercise a soothing and helpful effect. Invalids are often carried or wheeled into the Hop-garden at peeling time, and persons not dependent on the work have sometimes undertaken it simply for the sake of health and under medical approval or direction.

But let no bold spirits enter a Hop-garden, thinking to get the benefit of novel sights for nothing. By no means. The hop-pickers know what it means for a visitor to "pay his footing." The moment you go near one of the *binns*, a man or woman passes to the side of you, and sets over your feet as you stand a twig of hops, leaving it there; this is a sign that a "treat" is expected of you, and if you do not bestow enough to treat at least half-a-dozen persons to a drink of beer, you may be rather roughly handled—tumbled into a hop-*binn*, rolled and smothered among hops, punched, kicked, and beaten, till the scent of the hops may be an unpleasant memorial for you. Such things have been done to stingy people, whose proper place, think the hoppers, is not a hop-garden.

We were informed that recently, in America, a new piece of machinery had been brought into use which dis-

pensed entirely with the treading and turning over in the oast. The new American oast is square instead of round, and a machine works from each side by turns, completely turning over the hops and spreading them equally over the surface. But this invention has not yet found footing in England, and its general introduction would, of course, involve too great an expense.

In the Hop-garden, as elsewhere, the "later results" of scientific manufacture have lessened waste. The dried bines, under proper treatment, form one of the most valuable manures; while the shoots that have been left after cutting down are by-and-by pared off close to the "mound," bundled together, and sold to those paper-mills where the rougher kinds of grey and brown paper are made—forming, as we learn, the best strong fibre for the production of that particular article.

INDIA RUBBER.

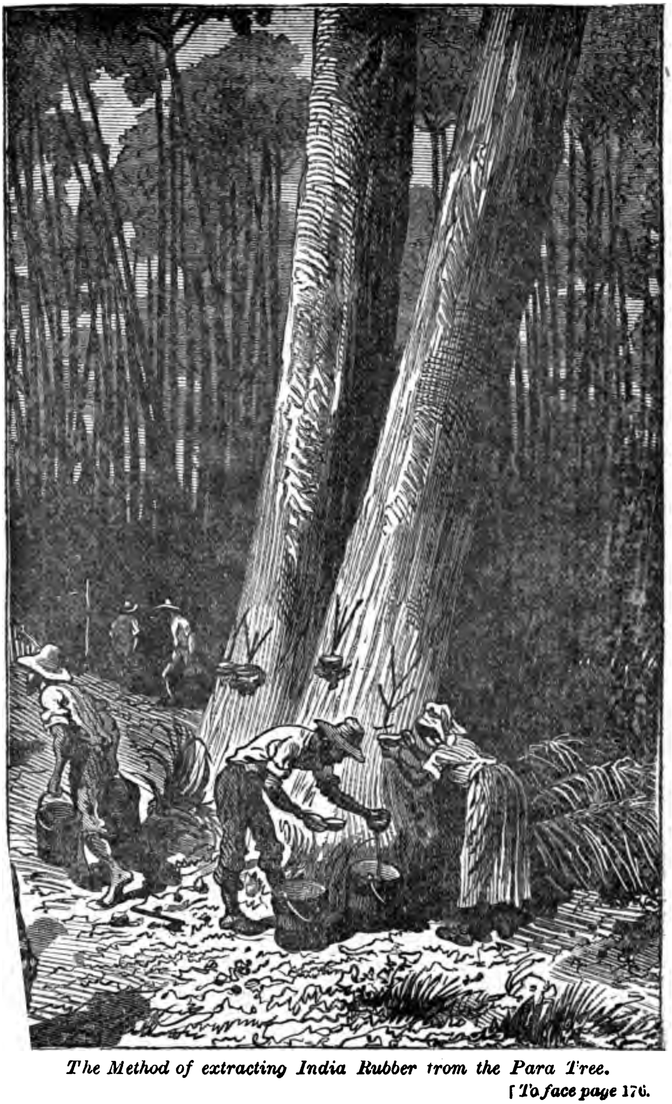
CAOUTCHOUC, or India Rubber, first made its appearance in England in those well-known grotesque figures of birds and animals. By-and-by, it was found very useful in erasing pencil-marks, and that circumstance gave to it the name it still popularly bears. Little information could for several years be obtained with respect to it, further than that it was a vegetable product. The first accurate information was obtained by a French geographical expedition, which reported the discovery of great numbers of trees known to the natives as Hevé. These were said to yield a large quantity of an elastic gummy substance identical with the caoutchouc which had shortly before been introduced into Europe. The India Rubber of commerce is now, however, furnished by many plants totally distinct from each other. The Para rubber, which is imported in larger quantities and fetches a higher price than any other, is furnished chiefly by *Hevea Brasiliensis* (*Siphonia Brasiliensis*, Willd.). Several other species, however, yield caoutchouc. The trees grow chiefly in the province

of Para, where they are found mingled with other trees in dense forests.

For details respecting the origin and the modes of obtaining the caoutchouc from the trees we are chiefly indebted to Mr Wallace, who was intimately associated with Mr W. H. Bates, the South American traveller. He tells us that the principal caoutchouc district lies between Para and the Xingui river, the trees being amongst some of the largest denizens of the neighbouring forests. They average 100 feet in height, and are two or three feet in diameter. The leaves are composed of three entire leaflets at the end of a leaf-stalk, and are clustered together at the termination of the branches. The flowers are small, and have a tubular calyx divided into five segments. They are unisexual, that is, the malo and female flowers are borne on the same panicle. The fruit is about the size of a large walnut, divided into three one-seeded lobes, which separate or split naturally when ripe. The seeds are mottled and shining, somewhat resembling the castor-oil seed.

The cells which contain the caoutchouc are quite distinct from the cells or vessels through which the ordinary functions of the plant is carried on. The vessels which contain caoutchouc and similar juices are called laticiferous tissue; they are exceedingly minute, and do not lie in any regular or definite position, but branch out in all directions. The contents of these vessels is called the latex, and is not milky in all plants, but is sometimes quite colourless. The caoutchouc, and similar elastic juices, are thus quite distinct from the ordinary sap of plants.

To collect the caoutchouc, the trees are tapped by making incisions in the trunk, from which the milky juice exudes into cups or small bowls made of clay. These wounds are, at first, always made at the uppermost part of the trunk, by which means the juice is drawn off down to the point of incision, after which another wound is made lower down and exhausted, and so on until the base is reached. The cups just referred to are fixed upon the trunk just below the wound. When the cups are full the contents are emptied into a larger vessel. Moulds of clay or earthenware are then dipped into the fluid rubber, and held over the smoke of a fire fed by the oily fruits of certain palms, which are collected in large quantities for this purpose, as they produce a thick black smoke which adheres to and soon dries into the caoutchouc. The moulds are several times dipped in the fluid rubber, and submitted to the smoke each time, until the caoutchouc is of a sufficient thickness, usually from one to two inches. When this has become thoroughly dry and hardened, the mould, which is securely fixed inside, is broken, and the pieces taken out through an aperture which has been left. The moulds formerly in use were in the shape either of rude bottles, or of figures and animals—the former being known for this reason as "bottle rubber." This kind of rubber is by far the purest, and is preferred by draughtsmen for effacing pencil marks. Caoutchouc as it exudes from the trees is white or milky, whereas that seen in use is generally more or less black; and the explanation is this: the soot and smoke from the fire in the drying-process



The Method of extracting India Rubber from the Para Tree.

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attaches to the surface of each layer; and hence, in cutting a piece of rubber, we find black streaks running through it close together in parallel directions. Nothing has been found more suitable for the drying-process than the palms of which we have spoken. Wood and coal have both been tried, but not successfully. The inflammability of caoutchouc has given the natives of Brazil an idea of using it as an illuminating agent. For this purpose they form the rubber roughly into the shape of a torch, and it is said to burn well with fair illuminating power.

The average imports of Para rubber amount to about 1500 tons per annum, and as many as 11,000 to 12,000 Indians are constantly employed in collecting it.

The well-known *Ficus elastica*, Roxb., of the East Indies, come next to the Para trees as a producer of caoutchouc. In its own country it is a rapid grower; in the short period of five years reaching from 20 to 30 feet in height. The average height of the trees is about 40 feet, but they have been known to attain to nearly 100 feet. From an official survey, it has been computed that in Assam over 43,000 exist on a space of about 30 miles by 8 of forest near Ferozepoor. These trees are prolific in their yield of the milky juice which furnishes about one-third of its weight of pure caoutchouc. The average quantity of fluid drawn from a tree at one operation is about forty-two pounds. About fourteen pounds of washed caoutchouc can be obtained from this. The process in Assam is this. Deep incisions about a foot apart are made transversely in the bark. The nearer the top the

greater is the flow. The richest juice, however, is obtained from the larger roots which descend to the earth from the branches, in a similar way to that of the well-known Banyan-tree. The juice, when freshly drawn off, is white, about the thickness of cream, but on being exposed to the air it separates itself spontaneously into a solid elastic form, leaving a disagreeable smelling fluid. The best time for tapping the trees is in the cold months; and now that the plant is better understood, they are generally allowed to grow undisturbed during the hot season. Humboldt tells us that the nearer the plants secreting this milky juice are to the tropics, they become the more productive.

The caoutchouc imported from the East Indian islands, Sumatra, and Madagascar, and known as Gintawan or Jintewan, is yielded by *Urceola elastica* Roxb. It was formerly supposed to be the chief source of Indian caoutchouc until the question was settled in favour of *Ficus elastica.*

Castilloa elastica, of Guatemala, and *Ficus Indica,* of the East Indies, are also productive of caoutchouc. It seems that, besides those trees we have named, there are many others that would yield more or less largely on proper treatment. Dr Royle, one of the Government Botanical Inspectors in India, writing on this subject, and referring to East Indian plants, says, "There might be any quantity of caoutchouc procured from a great variety of plants if the natives could only be induced to collect it with sufficient care." As the demand for India Rubber has increased enormously within the last few years, any

fresh source of supply must be looked upon with interest. Caoutchouc-yielding plants belonging to the Apocyneæ, a species of Carissa, and a Carpodinus, have been found in many parts of Central Africa and samples of the caoutchouc have been shown, which was of good quality.

A great number of inventions have been applied from time to time to the working of this material. Mr Thomas Hancock, of the well-known firm of Charles Macintosh and Co., is one of the earliest inventors and improvers, and his name must always be mentioned in connection with it. The chief use of India Rubber in this country, before his attention was devoted to its development, was as we have said, that of erasing pencil-marks from paper. About the year 1819 his first experiments were made for extending its utility; and these were so successful and have so stimulated others to effort in the same field, that nowadays the use of caoutchouc is almost universal. The benefits we derive from it are very great. Its remarkable power of not absorbing moisture has caused it to be used extensively for articles of clothing. Envelopped in a thin film of India Rubber, called a macintosh, we can almost defy the rain even amongst the "Scottish lochs and islands." Air-cushions and water-beds, so useful in hospitals and in the treatment of the sick, we owe to caoutchouc. India Rubber also forms an insulator for the wires of deep-sea telegraphs. Paraffin in combination with India Rubber is said to afford a much more perfect insulator than any previously known. Caoutchouc, as imported, is all more or less impure, and the

first operation in our home factories is to remove impurities. It is softened by warm water, and then ground up in an iron case, in which iron rollers revolve at different velocities. It is then rolled and ground till it is worked into a kind of sticky pulp and quite smooth in the texture. To prepare it for solid sheets, it is put into a hydraulic press and condensed into a solid bulk. It can now be cut into sheets of any thickness by being pressed against a knife working with a lateral motion. So fine can this machine cut the substance, that it comes off in films finer than the finest specimens of silk ribbon. The greater mass of the rubber, however, is not reduced to solid form, but is treated, while it is still liquid, with sulphur. This gives it increased elasticity, and it is also temporarily treated with naphtha. Rubber thus mixed is known as white rubber.

When it was found that India Rubber could be dissolved in oil of turpentine, a great advance in manufacture had been attained. A waterproof varnish of great value was the practical result. *Macintosh* cloth for capes and coats and leggings is nothing but two pieces of cotton or silk cemented together by a thin varnish of India Rubber and thus made waterproof.

India Rubber is now also much used for the spring-sides of boots, for braces, gloves, and many similar purposes. This is, perhaps, the most delicate manipulation that India Rubber undergoes. The inventor of this process is said to have been an officer in the Austrian army. The caoutchouc for this purpose must be very pure, and com-

mands a high price. The rubber is first cut into lengths of the width and thickness required, and as such it is called India Rubber tape. This is then cut down into fine threads by young girls. By the mere operation of winding, heat is given off, the threads are much stretched, and are thus made to lose their elasticity, which is absolutely necessary for the purpose of weaving. An apparatus called the "Braiding Machine" is then called into use. Each thread is carefully covered with cotton, silk, or whatever material is to be used. The threads at this point are quite unelastic, and capable of being woven, and in this condition they are removed to the looms for weaving. This is done entirely by machinery and with great rapidity. The elasticity is restored by the simple application of heat to the finished tissue. The invention of treating caoutchouc with sulphur, or vulcanising, was a great step in extending its usefulness. By this process India Rubber is hardened and made to take forms and shapes not before attainable. This branch of the India Rubber manufacture has been carried to a high pitch of perfection. As a result we now have drinking vessels, and other domestic articles, umbrella handles, knobs for walking sticks, and other useful and ornamental nicknacks made of India Rubber.

Perhaps the prettiest modern application of hard vulcanised rubber is that of imitation jet. Some of these more costly articles are partly moulded and then carved by hand. It is less liable to break than jet is, and it is also light and wears well. For such purposes as require a great degree of elasticity combined with a capability to support heavy

weights, the caoutchouc is made in a porous state, or in large blocks made hollow. These are placed one upon another till they are sufficiently strong for the work required; they arc then cemented together, and form apparently a single block. Rubber can be vulcanised of different degrees of hardness. An ordinary elastic band is vulcanised as well as the jet-like jewellery.

One of its most successful applications is, perhaps, in the manufacture of kamptulicon, which is now coming much into use. This, we understand, is composed of caoutchouc and cork, and is well adapted from its toughness and other qualities for the purpose of floor-cloth.

India Rubber and gutta-percha have now got their places in English manufacture, and there will, no doubt, always be a great and growing demand for them. We can scarcely expect any new substance entirely to supersede them, though we may reasonably enough look to new sources for fresh products to work with, and to combine with them.

PERFUMES.

It has been said that smell is the most potent of the senses—in reviving memory, in reawakening associations. If this be so, the perfumer might well be called a banker of sweet sensations and thoughts. Thomas de Quincey said of opium, his pet dose, just after he had discovered its mystic potencies: "Here was a panacea, a φαρμακον νήπενθες for all human woes; here was the secret of happiness, about which philosophers had disputed for so many ages, at once discovered; happiness might now be bought for a penny, and carried in the waistcoat-pocket; portable ecstasies might be corked in a pint-bottle; and peace of mind could be sent down by the mail."* Perfumes, too, are "portable ecstasies," and can be carried in the waistcoat-pocket, corked in the very smallest of bottles; talismans to lure *back* the blisses of the past—the sweet treasures of association and even of hope; keys to unlock the golden doors of a world of dreams, of soft reverie, and dim faint persuasive fancies and imaginings. This is the

* "Confessions of an Opium Eater," p. 195, ed. 1862.

poetic side of the subject, interesting to the psychologist and philosopher. The practical side, or the history of perfumes, viewed in their manufacture, is perhaps hardly less curious, interesting, and suggestive.

Fourcroy divided odours into five series, and De Haller into three; but Rimmel, in an elaborate and exhaustive treatise on the subject, made a new classification, comprising only pleasant odours, on the principle that, as there are primary colours, from which all secondary shades are produced, so there are primary odours, with types; all other aromas being more or less closely connected with them. Of these types he finds eighteen groups, embracing the following classification :—

1. The rose series — including geranium, sweetbriar, rhodeum, and rosewood. 2. The jasmine—including lily of the valley. 3. The orange flower—including acacia, syringa, and orange leaves. 4. The tuberose—including lily, jonquil, narcissus, and hyacinth. 5. The violet—including orris root, and mignonette. 6. The vanilla —including balsam of Peru and Tolu, benzoin, styrax, Tonquin beans, and heliotrope. 7. The spice—including cinnamon, cassia, nutmeg, mace, and pimento. 8. The clove—including carnation, clove, and clove pink. 9. The camphor—including camphor, rosemary, and patchouli. 10. The sandal—including sandal wood, vertivert, and cedar wood. 11. The citrine—including lemon, bergamot, orange, cedrat, and limette. 12. The lavender—including lavender, spike, thyme, surpolet, and marjoram. 13. The mint—including spearmint, peppermint, balm, rue, and

sage. 14. The anise—including badiane, carraway, dill, coriander, and fennel. 15. The almond—including bitter almonds, laurel, peach kernels, and mirbane. 16. The musk —including musk, civet, musk seed, and the musk plant. 17. The amber—including the ambergris and oak moss. 18. The fruit — including the apple, pineapple, and quince.

Though certainly comprehensive, this can hardly be called an exhaustive classification, since there are some fruits not taken note of here—the melon, for instance, with its quaint, rich perfume.

Odours differ not only in quality but in intensity. Some are so intense that certain persons actually suffer from inhaling them, realising the somewhat paradoxical expression of Nathaniel Hawthorne that "pain is only pleasure too strongly emphasised;" other odours, again, are so faint and subtle as to require a special fineness of sense to detect them. These, however, are the most insinuating and powerful in mental association where they are perceived—illustrating, once more, a refined law of association. And some odours have a marvellous persistency. A single grain of musk, as every one knows, will suffice to scent a room for years without losing any appreciable part of its weight — a point which has given rise to contending theories.

Some hold that imperceptible particles must actually reach the olfactory nerves to leave impressions on the brain; others hold that the odour exists only in the imagination. Some have even argued that the impression is

materially aided by the sense of sight, and an attempt has been made, in support of this theory, to prove that with the blind the sense of smell is imperfect; and that it is more difficult to stimulate the olfactory nerves in darkness than in light. This latter is a theory which, we must add, has not been supported by facts; for tests, scientifically applied, have not established the assertion that there is a necessary obtuseness, or lack of delicacy, or of quickness in the olfactory nerves of the blind.

There are two chief processes by which odoriferous essences are extracted and retained. One is by distillation, or what is called maceration—the essential oil in which the perfume resides being extracted by heat from the flowers, leaves, and roots, or other portions of the plants containing it. The other, and by far the more delicate and interesting, is by absorption, or *enfleurage*, which is resorted to in the cases of all the more delicate flowers, such as roses, jasmine, tuberose, cassia, where the essence is so fine that it has, by practice, been found to be injured by heat. Scientific men, nowadays, speak much of "elective affinity," by which the most unlikely elements not only come into combination, but undergo such transformations in each other's arms as realise to the full the ancient fables of Proteus. That god took all shapes, passing, as it seemed, at will, from the most ungainly to the most beautiful and pleasing, to evade too direct questioning. So it is in science and in manufacture where science is most applied. When we think of the exquisite colours now obtained from the coal-tar, which used to be thrown away

as waste in cart loads from our gas factories, the fable of Proteus seems to be transacted before us at the beck of science; and hardly less so is it in the principle of odour-absorption from flowers. To put it in plain language, this is based simply on the established law of affinity which hydro-carbons—that is, beef and mutton fats—have for perfumes. When these have been highly purified, they catch, and in catching, concentrate and intensify the odours communicated to them; and the *modus operandi* is one of the simplest. In the perfume factory we see multitudes of wooden frames with rims about three inches in depth, and in the middle of these frames glasses are inserted. They look, at a general view, exactly like big window panes. The next thing we see is that these frames are lifted to a bench, and the glasses all spread over on each side with layers of pure fat, less than a quarter of an inch in thickness, and over these layers are carefully shed the leaves of flowers that may be plentiful at the season, fresh and full of odour. After the flower-leaves are spread out, layer is in the same way laid upon layer of fat, with flower leaves between, till each glass in its frame now looks like a solid box of fat. These frames when full are placed in large boxes, made with shelves or spaces fitted exactly to receive so many of them; and the boxes are, for a time, kept closely shut. In a very short time the fat has caught all the odour—caught it, and holds it so firmly that it can be thus conveyed for hundreds of miles, for example, between Cannes and Paris, where the odours arrive "as pure as the day they were given forth by the flowers themselves."

Another method is to spread the flowers upon cloths saturated with oil, and when the cloths, which are put with the flowers under a heavy pressure, are sufficiently charged to recover the essential oil, they are subjected to a press specially designed to accomplish the object.

Perhaps the reader will now ask: But how is the odour once more freed from the fat, which has proved itself the more powerful agent in the process? By another operation of that law of elective-affinity of which we have spoken; and, truly, no fairy-tale could exhaust the surprises and the wonders of these laws as revealed by science and applied to manufacture, realising to the fullest the weight of the words of the Prince Consort, which we have chosen for our motto. It is freed by the affinity of a yet more powerful and spiritual solvent. As the old gods were defeated by the Titans, so, in this case, the oils are defeated by spirits; and this is the manner, as simple as it is astonishing, by which it is done! The fat is cut up into small square portions, and these are put into spirits of wine. On this the delicate essence parts from the coarse fat, and finds its portion with the choicer and rarer element. It is then bottled in glass-stoppered bottles, as we see it in the shops, and is sent far and near to do its own work in the world. As a rule, a single odour is used for a perfume; though, as in *eau de Cologne*, *eau de Florida*, and other odoriferous waters, there is a combination of several essential oils with the spirits of wine.

In the preparation of scents, just as we have seen in so many other things, the early men or ancients anticipated,

in principle, the most recent methods approved of science, and severely based upon its rules. Ben oil was with them the great and efficient agent. It was obtained from the *Moringa Zeylanica or oleifera,* a tree which grows in Egypt, India, and Ceylon. It bears a pod containing several peculiar-shaped, three-cornered seeds. From these seeds a pure and scentless oil is obtained. Cotton was soaked in this oil, and placed in layers between the flowers, and then pressed down in a water-bath for about twenty-four hours. The oil, immediately afterwards expressed, was found to have retained all the odour of the flowers.

Evidently the method has not varied much in different periods; for we find the quaint Culpepper, in his "English Physician," of 1653, giving much the same process in his old-fashioned way, the spelling being faithfully preserved by us:—

"Having bruized the herbs or flowers you would make your Oyl of, put them in an earthen pot, and to two or three handfuls of them pour a pint of Oyl, cover the pot with a paper and set it in the Sun, about a fortnight or less according as the sun is in hotness: then, having warmed it very wel by the fire, press out the herbs, &c., very hard in a press, and ad as many more Herbs to the same Oyl, bruize (the Herbs, I mean, not the Oyl) in like manner, set them in the Sun as before; the oftner you repeat this, the stronger will your Oyl be: at last when you conceive it strong enough, boyl both Herbs and Oyl together till the juyce be consumed, which you may know

by its leaving bubling, and the Herbs will be crisp, then strain it whiles it is hot, and keep it in a stone Vessel for your use."

Heat, however, has been found to exhaust in a certain measure the power of the scents, and, in some instances, altogether to destroy the fainter ones.

The old method is, in general principle, however, identical with the process by which the more delicate scents are, as we have seen to-day, extracted and retained for use in many ways.

The commercial importance of this floral industry is seen in the fact, mentioned recently by Dr Schomburgk in his report on the Botanic Gardens of Adelaide, that in Europe and in British India alone, 150,000 gallons of handkerchief-perfume are annually consumed, while the revenue from perfumes imported into Britain is estimated at £40,000. To produce this, an enormous quantity of flowers is required, the great bulk of which are specially grown on extensive farms at Grasse, Cannes, and Nice, where distilleries exist for the manufacture of the perfume. The largest of these is at Cannes, where, it is said, 100,000 lb. of acacia flowers, 14,000 lb. of rose petals, 32,000 lb. of jasmine blossoms, and large quantities of other perfume-producing plants are annually used. There are several very large gardens of the same sort in England, and among them one or two in which lavender is a special product—reared exactly like grapes, or corn, or wheat, with a view to its being treated, as we have seen, by the perfumer. Dr Schomburgk, in his report, strongly advocates the esta-

blishment of flower farms in South Australia, where such valuable scent plants as mignonette, sweet verbena, jasmine, rose, lavender, and acacia "thrive probably in greater perfection than in any other part of the world." To export, however, the flowers to Europe for distillation, as he suggests, would probably prove a mistake, as they would be certain to deteriorate by the way in scent-producing quality, the commercial success of the flower farms of southern France being due, it is said, in no small measure to the fact that the distilleries are situated in their midst.

GOLD AND SILVER.

THE "curse of Gold" was, in one aspect, illustrated by Thomas Hood in his ballad of "Miss Kilmansegge." That was grotesque, and the improbabilities are only made amusing by the fertile fancy and keen wit of the author. But the broad page of history relating to Gold is itself almost a grotesque, as gigantic as it is pathetic and appalling in the cruelty and the misery with which it is everywhere associated. Christian and heathen, ancient and mediæval, the record has but one lesson—a lesson of pain and terror, of wholesale massacre, slavery, and degradation unspeakable. The simpler peoples are overwhelmed by the more civilised, who, in extending the area of their conquests, are smitten by the "Gold-hunger," and bear off over lands soaked with blood and tears the shining treasure, to accomplish its "certain work"—their speedy decline and degradation far beneath the level of the semi-savages they had oppressed and slain. Ill-gotten gains bring their own punishment, and Shakespeare speaks of a power that "wrongs the wronger till he render right." Gold would

seem to be so certainly the messenger of this power, that the historians of the precious metals, however calm and precise and unpoetical, are, perforce, the writers of tragedy that should justify itself to all men in "purifying by fear." Even in the later and more peaceful aspects of Gold-digging, the results are less attractive than would appear at first view. If the oppression and the rapine and the murder disappear, the tale of moral evil and degradation remains too much the same.

As in the case of so much else the first use of the precious metals as money may be traced to India. In the Code of Menu there are specific instructions given respecting the insurance of goods in transit, whether by land or water, and also indications concerning payment, sufficient to suggest that Gold and Silver were then in ordinary use as money. Pliny, quoting from older authors, speaks of immense Gold and Silver mines in India; but it would seem that, in course of centuries, these became exhausted, and that, for a considerable period before Pliny's era, the people of India had procured supplies of Silver, probably also of Gold, through the Phœnicians, from Greece and Spain. Gold is still extracted in small quantities from the sands of streams which issue from the Himalaya mountains and from the head-waters of the Ganges. The rivers of the Deccan, of Orissa, and of Berar, still carry down Gold. Some of the rivers of the Punjaub and of Cashmere contain golden sands. So of the Sutlej and other streams in the neighbourhood. Gold and Silver mines also occur in Golconda, the Carnatic, Assam, and Bengal; and there are

circumstances connected with some of these deposits of the precious metals which indicate that they were worked in very ancient times. When Phœnicia was subject to Persia in the sixth century before Christ, she was compelled to pay tribute in Silver, presumably because the Persians could make a profit in exchanging it with India. The Persians, in their Gold-hunger, carried to the East all the precious metals they could obtain in their extended conquests; and to this fact is to be attributed the exhaustion of the mines of Spain, as the exhaustion of those of Phrygia was to be attributed to the Lydians.

The military expeditions of the Persian Darius were undertaken mainly for the acquisition of Gold and Silver. He levied tributes of these metals on those he subdued to the extent, say Gibbon and Rennel, of about three-quarters of a million sterling annually. The excessive demands of the Persian monarch, and the cruel mode in which the tax was exacted, led, in the course of a few years, to the revolt of the chief states which once more declared their independence.

As power passes from the hands of one nation to another in these distant days, we see, as if by some inevitable law, that there passes also the passion for Gold, destined soon to weaken each in turn. Persians, Carthaginians, Phœnicians, Egyptians, all had carried their power to far lands, and all had compelled the conquered to become mere agents for collecting Gold and Silver. What is said of the Carthaginians may be said of all. "These people" says Diodorus, speaking of the aborigines of Spain, "though by

their labour they enriched their masters to an almost incredible extent, did it by toiling night and day in their golden prisons. They were compelled by the lash to work so incessantly that they died of the hardships in the caverns they had dug. Such as, by great vigour of body, continued to live, were in a state of misery which rendered death a preferable fate."

As the Persians, Carthaginians, and Phœnicians had done, so did Alexander first and then the Romans after him. Alexander reigned only twelve years; yet, during this brief period, his passion for acquiring the precious metals, which has been by historians transmuted into love of conquest, cost the lives of several millions of human beings, and the freedom and happiness of other millions whom he condemned to slavery and wretchedness. The pecuniary results of his expeditions are given at twelve millions sterling in Gold and Silver, plundered from Babylon and Susa, and twenty millions in the same metals from Persepolis and Pasargarda. This does not include the spoils of Bactria, Judea, &c. The spoil of Persia alone is calculated at from forty to fifty millions.

In all cases the Gold corrupted the government, and led to the neglect of military discipline and precaution; it introduced slavery and begot an inveterate dislike of industry and labour of all kinds. Instead of honest work men began to gamble, and one after another the nations of antiquity fell, entombed beneath the Gold, or the grandeur that the Gold had gotten, never to rise again. Even Rome, so long as she still held to her copper tokens

and remained free from the Gold-lust, was great, free, victorious; the moment, under the fever of conquest, she succumbed to the temptation, weakness and disintegration set in, and, along with other causes, the Gold-lust worked her ruin also. Scipio's conquest of Spain, and the treasure that he bore thence to Italy, introduced effectively the awful poison. The subjugation of the Carthaginians—and "it was a glorious victory" that next century laid Carthage in the dust—was the Knell of Rome. Myriads of the inhabitants of Carthage were carried to Rome and sold in the slave-markets, or condemned to the hideous labour of the Spanish mines. History has written its eloquent and ineffaceable condemnation of slavery in all its forms; no nation has yet succeeded in making slaves of others, and not themselves speedily sinking to the lowest level of degradation, idleness, lust, incapacity for union, and helpless perversity which led to ruin. Cæsar's expeditions into Gaul were simply a series of forays; his exactions from the conquered were firstly for Gold in sight, and secondly for Gold not in sight, and thirdly for slaves to produce Gold either by forced labour or through exchange. When, as immediately after the last Punic war, the Roman generals began unblushingly to convert to their own use the spoils gotten abroad, the glory had passed from Rome. "The Romans were like brothers in the brave days of old," but no men can long be brothers, if the Gold-demon gains ground in their midst. Envy, jealousy, incapability of friendship or of self-denial ensues. Society has no longer any principle of coherence and can withstand no powerful attack.

The history of the middle ages is made mournful by the same phenomena; we pass on to the later conquests that ensued on the discovery of the New World, to see how in every essential element they repeat the story of earlier and classical times. As the mines of Spain formed the ancient Dorado to the Phœnicians and Carthaginians, so Peru and Mexico formed the Dorado of Spain.

"Spain," says Mr del Mar, in his valuable volume on the Precious Metals, "was to the ancients what Mexico and Central and South America became in later ages to Spain, the Dorado, the richest mining country in the world, the place where Gold and Silver were found in the greatest abundance. The fate of its aboriginal inhabitants, the subsequent struggles among leading nations for the mastery of its precious metals, the destruction of its forests for the purposes of the mines and the consequent exposure of its soil to drought and devastation, the neglect of agriculture in the absorbing pursuit of metallic wealth, and the resulting poverty and backwardness of its population, both aboriginal and colonial—can all be read by the nearer pictures which are accessible to us of Mexico and Peru!"

And what are these? Two or three may stand as sample of all. In Peru, in Mexico, in Darien, in Panama, in Brazil, in Honduras, it is the same; deceit, plunder, murder and slavery. There is not an instance of the development of a noble virtue in the contact of a higher race with a lower in this mad search for Gold. The frank and hospitable simplicity of the Indios and other races in contrast with the mean and truckling cruelty of European adventurers

and robbers, who went forth with the charter of "Christian" kings, and the blessing of "Christian" bishops, might well make an ingenuous reader still blush for shame over the pages that record it.

The hands of the great Columbus himself can by no means be held to be clean. There was one chief Guacagnari, who ruled a district in Hispaniola, on whom it was deemed expedient to make war, notwithstanding that he had received the Spaniards with kindness, and done them many favours; the Spaniards themselves describing his people as loving and uncovetous, and as those "who always spoke with a smile." On them Columbus made war, presumably to obtain more Gold, or to show that his request for leave "to enslave the natives" had not been without result. The soft and naked bodies of the Indios not being proof against horses, firearms, or ferocious dogs, a horrible carnage ensued, and another bloody instalment was paid toward the cost of Gold. Columbus caught the cacique, Caonabó, through the vilest treachery, and imposed a tribute of Gold upon the entire population of Hispaniola. The tribute was this: every Indio above fourteen years old, who was in the provinces of the mines, or near to these provinces, was to pay every three months a little bell-full of Gold; and all younger Indios an arroba of cotton.

When this unreasonable tribute was enforced, Guarionéx, cacique of the Vega Real, said that his people did not know where to find Gold, and offered in its place to cultivate a huge farm, fifty-five leagues long, covering the whole island, and to produce from it corn enough to feed the

whole of Castile. Poor Indio! This was surely a mere suggestion of despair. Hispaniola, at the utmost, did not contain more than 1,200,000 Indios, man, woman and child. Castile contained a population of 3,000,000 or 4,000,000. An attempt to feed a population so large by one so small, and at a distance of 4000 miles, could only have ended in failure. But their Catholic majesties wanted not bread, but Gold; and this was what, in their names, Columbus was bent on obtaining. Yet, however much he desired it, the Gold could not be collected, simply because there were no Gold mines of any consequence, only some poor washings, in Hispaniola, from whence it might be got. Columbus was, therefore, obliged to change the nature of his oppressions. This was done by reducing the whole native population to vassalage; and thus, in the year of our Lord 1496, was begun the system of *repartimientos* in America. And thus did Columbus—the brave, heroic Columbus, "my sea-captain, royallest hero of all,"* reward the unparalleled kindness of a loving, uncovetous people, who "always spoke with a smile!"

Cortes was no better than Columbus, perhaps worse. In 1522, he sent Alvarado to Guatemala. The innocent natives received him kindly, hospitably, according to his own account. After their kind treatment he demands Gold. Gold to the extent of 30,000 pesos is given him; then, cupidity being only excited by gift, he demands more. The cacique tells him he has had all, that no more is left.

* Thomas Carlyle.

Alvarado then threatens the cacique with death if he does not bring more. The cacique then sends out messengers to scour all the country for Gold, and collects all that can be found. This is given to the heroic Spanish captain who then, by way of reward, treacherously puts the cacique in prison, where he dies; Alvarado devoting himself to ravaging the country and terrifying the inhabitants, and in one day putting to the sword as many as 30,000 natives, while in a second battle he surpassed this. To the credit of Bernal Diaz, be it said, that he protested against Alvarado's cruel treachery, which, however, was yet to be exceeded by that of Pizarro.

An incident from the history of Panama may well follow here:—

"In Espinosa's expedition, there was a Franciscan monk, named Franscisco de San Roman. After this priest returned to Spain, and while in the Dominican College of San Tómás of Seville, whither he had retired in disgust at the world, he stated that he had seen with his own eyes, killed by the sword, or thrown to savage dogs, in this "murderous" expedition of Espinosa's above 40,000 souls. In addition to this, Espinosa brought into Darien from the same expedition 2000 Indios, whom he branded for shipment as slaves to Hispaniola, all of whom perished in a short time, some at Darien, some on the voyage, and the rest in the mines of Hispaniola. The net proceeds of this foray were 80,000 pesos of Gold, so that the immediate cost of every two pesos was more than one human life. It would be curious to learn how the politico-economical

axiom that "value is determined by cost of production," can be reconciled with such an instance of the cost of Gold by conquest. All the expeditions of this period were of the same general character. They were all planned to obtain Gold; and red-handed, cruel murder, was the sole means employed. Yet, withal, they failed; failed from the simple fact—which the delusive dreams of the eager adventurers never permitted them to observe—that the Indios had no Gold beyond a few trinkets which had been wrought from the scant findings of seldom-searched places by many generations of men. They did not use Gold money; they did not need Gold for this or any other useful purpose; they had no Gold quartz mines, and knew not how to work them if they had possessed them; so that in the end, and without counting the cruel and needless sacrifice of native life, the Spaniards failed to obtain sufficient Gold to pay the expenses of their expeditions and the colonial establishments. Notwithstanding these experiences, the Crown of Spain still believed in the advantage of searching for Gold in the Indies. Yet the failure of the Darien Colony was so complete, that the Gold-smelting house at Darien had to be closed for want of supplies; and so obvious that it was acknowledged even by statesmen in Spain, who were too remote from the scene of operations to learn much about the cost or the nature of the Gold forays, and were always the last to abandon, because they reaped the most from these expeditions."

Sir Arthur Helps says generally of the Spanish conquest:—

"If mere destruction of life, the life of men like ourselves, be taken into account, this conquest and its consequences will be found to be one of the greatest transactions in history; for, however we may grieve to hear it, further research only more and more supports the statement of Las Casas, who was wont to estimate the loss of lives by millions, a way of talking which has ever since seemed to imply great exaggeration, but which we must henceforth listen to with respectful attention, if not with complete assent.

"It is curious that, in the works of a rough soldier of that period (Diego de Vargas Machuca), who merely aimed at giving an account of how Indians should be made war upon, there is a keen perception of what was the real difficulty of the conquest,—the division of the spoil. This spoil consisted at first of what trinkets or ornaments of Gold were found in the possession of the natives. These being exhausted, the spoil next came to consist of tributes of Gold, which the natives were ordered to bring to the Spaniards. From the simple fact that the former possessed but little Gold, knew not were to find more, and as for mining in new veins, knew little or nothing of it, these tributes quickly fell away, and the spoil next assumed the shape of the natives themselves, who were seized upon by their conquerors, forced into the mines as slaves, and condemned to labours so exhausting, that, in the course of a few months after being thus condemned they invariably perished."*

* Help's "Spanish Conquest," Vol. iii. pp. 116-119.

Well might Columbus write home to the Government of Spain, "I swear that numbers of men have gone to the Indies who did not deserve water from God or man," and it was the same with those who went from other countries than Spain. "The vilest scoundrels" says Sir Arthur Helps, "were let loose upon the unoffending aborigines of America, and the darkest and most detestable crimes were committed in the sacred names of God and the Trinity; and to these cruelties, the necessities of the Crown of Spain—bred by usury, indulgence, and lust—opened the way."* A letter of King Ferdinand to the Colonists of Hispaniola, is thus fairly paraphrased: "Get Gold humanely if you can; but at all hazards get Gold; and here are facilities for you."† As a last resource, sometimes, the native rulers had recourse to duplicity and to invention to rid themselves of their tyrants. They would contrive to get the white men impressed with the idea that a rich Gold field lay at some distance in a neighbouring territory, and, in too many cases, they thus purchased an exemption, often, however, only temporary, from their presence and their exactions by delivering over other tribes to merciless demands and atrocities. As illustrative of this, the following may be given from Mr Ascott Hope's account of the attempt of the French to colonise Florida. The same tragedy was transacted there as before by the Spaniards—there is no relief either from methods or

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* Help's "Spanish Conquest," Vol i. p. 161.

† Help's "Spanish Conquest," Vol. i. p. 241.

results in the Gold chase—only the actors change upon the stage:—

"Satouriona was the head of one Indian confederation, and higher up the river to the south lay a group of hostile tribes, who obeyed the chief called Outina. The former, soon finding the foible of the French, informed them that his rival's territories abounded in Gold and Silver. He hoped thus to induce them to join him in attacking this country, which was known as Timagoa. But the effect of his information was the very reverse of what he intended; Laudonnière desired an alliance with the people through whom his followers were to be enriched, for these Protestants had not enough religion to prevent them from being covetous of riches, yet enough to make them scruple about the plan of getting riches through cutting throats, if any other means were possible. He accordingly sent his lieutenant, Ottigny, with a few men, on a reconnoitring expedition up the river. For many a league they stemmed the broad waters, broken here and there by floating islands of aquatic plants, and with shores often so low that for a mile or more the ground would be a foot deep in water, though the long grass rising above the surface made it seem like a vast meadow; then, again, would come bluffs and oak-covered hummocks, and luxurious forests growing down to the water's edge. Indian guides accompanied the little party of soldiers, exulting in the prospect of seeing their enemies fall before the mysterious flash of the arquebus. But to their extreme discontent, when Ottigny fell in with three canoes of Timagoa, he took care to move so

slowly to the attack, that the savages had time to paddle to shore and escape into the woods. Then placing trinkets in their canoes as sign of amity, he managed to lure them back, and entered into friendly intercourse with their tribe.

"Soon afterwards, a second expedition was sent up the river under another officer named Vasseur, who visited one of Outina's chiefs, and soon displaying the object of his mission, was gravely informed that he had not yet come to the right place for Gold. That was to be had for the taking it in the country to the north, ruled over by Potanou, who was of course a deadly enemy of Outina's tribe. And as Laudonnière had promised to aid Satouriona against Outina, so now Vasseur entered into alliance with Outina against Potanou. In their blind thirst for Gold, the Frenchmen did not wait to be off with the old friend before they were on with the new; thus their relations with these three surrounding states soon grew perplexingly complicated.

"On their way home Vasseur and his men became the guests of one of Satouriona's subordinate chiefs, in whose wigwam they were witness of an extraordinary scene, illustrating the ferocity of Indian manners. They deceived this chief by declaring that they had routed the people of Timagoa, and one of the officers went through the pantomime of thrusting with the sword, making as if he had killed two men. Some suspicion was excited by the fact that no stains of blood were to be seen on the blade, but it was explained that the weapon had been washed. Won-

dering at the strange manner in which these foreigners made war, their host, nevertheless, set the commander in his own seat, and honourably entertained the party with a beverage called *cassine,* or 'the black drink,' made from the leaves of a plant, and much esteemed among the natives. Though its effects were to produce copious perspiration and often sickness, it was considered a nectar for warriors; and, as a squire of last century despised a man who could not toss off his bottle of port or claret, so here it was a reproach not to carry this liquor well. Then as they were drinking, 'he which brought it set the cup aside, and drew out a little dagger stuck up in the roof of the house, and like a madman he lift his head aloft, and ran apace, and went and smote an Indian which sat alone in one of the corners of the hall, crying with a loud voice, *Hyou,* the poor Indian stirring not at all for the blow, which he seemed to endure patiently. He which held the dagger went quickly to put the same in his former place, and began again to give us drink as he did before; but he had not long continued, and had scarce given three or four thereof, but he left his bowl again, and took the dagger in his hand, and quickly returned unto him which he had strocken before, to whom he gave a very sore blow on the side, crying *Hyou,* as he had done before, and then he went to put the dagger in his place, and set himself down among the rest. A little while after, he that had been stricken fell down backwards, stretching out his arms and legs, as if he had been ready to yield up the latter gasp. And then the younger son of the Paracoussy, apparelled in a

long white skin, fell down at the feet of him that was fallen backward, weeping bitterly half a quarter of an hour; after, two other of his brethren, clad in like apparel, came about him that was so stricken, and began to sigh pitifully! Their mother, bearing a little infant in her arms, came from another part, and going to the place where her sons were, at the first she used infinite numbers of outcries, then one while lifting up her eyes to heaven another while falling down unto the ground; she cried so dolefully that her lamentable mournings would have moved the most hard and stony heart in the world with pity. Yet this sufficed not, for there came in a company of young girls, which did never leave weeping for a long while, in the place where the Indian was fallen down, whom afterwards they took, and with the saddest gestures they could devise, carried him away into another house, a little way off from the great hall of the Paracoussy.

"The Indians looked on stolidly, and drank their cassine in deep silence, but the visitors were naturally somewhat amazed by these unaccountable proceedings, and still more so when, on going into another wigwam, where women were tenderly dressing the victim's wounds with moss, it was explained to them that they were the innocent cause of his sufferings. This chief, if they understood aright, bore such an hereditary hatred against the Timagoans, that as often as he or any of his friends or allies returned from their country without bringing scalps or prisoners, he was accustomed, by way of venerating the memory and lamenting the injuries of his ancestors, to inflict upon his

best beloved son wounds of the same kind as those which still remain unavenged, to which the sufferer, as was seen, submitted with Indian stoicism. It must be agreed that, inconvenient as the etiquette of polite society sometimes proves, we should do ill to exchange it, as some enthusiasts have proposed, for the ceremonial observances of savage life.

"Satouriona now began to press for the performance of a promise of military aid given him in a rash moment by Laudonnière, who soon saw reason to excuse himself from its execution. The policy and the principles alike of the French leader inclined him to be a peacemaker, but he found it impossible to hold his savage ally in check. On the strength of this promise, the Paracoussy had already summoned his army; five hundred warriors were ready to follow him, and would not go home till they had tasted blood. Invoking the sun with fierce rites and incantations, he took the war path towards the country of Outina. The raid was successful; a village was destroyed, and the victors returned, exulting over the scalps of the slain and a drove of prisoners, whose fate was even more to be pitied.

"Amid the mad gambols and shouts with which this triumph was welcomed, Laudonnière conceived the idea of getting some of these unfortunates into his own hands, that he might send them back to their people as evidence of his goodwill. He accordingly desired Satouriona to give him two of the prisoners. The chief refused, and the Frenchman took an odd way of bringing him to reason.

With twenty men he marched to the rude palace of posts and bark, now decorated with scalps and wreaths of laurel, and presented himself unceremoniously to its master, while his men were left without, ordered to let no one pass. Giving no salutation or sign of friendship, Laudonnière placed himself beside the chief, and sat there without speaking for half an hour, 'which thing put him deeply in his dumps,' then only breaking silence to repeat his demand with haughty assurance. Satouriona was in fact so deeply impressed by this high-handed manner of recommending lessons of peace and mercy, that, after evasions and delays, he gave up the prisoners as required, and they were conducted to Outina by an escort of soldiers, charged also with presents and friendly messages.

"This party undertook duties scarcely consistent with the character of an embassy. By the promise of golden spoil, some half-a-dozen of them were induced to join Outina in an expedition against Potanou. Borne on the shoulders of Indians through the swamps and thorny thickets, the little band of soldiers did not fail to render good service to their employer. Outina's forces, with these allies in the van, were like a steel-headed spear, matched against an unwieldy club. At the first fire the leader of the enemy fell dead, and his men, terrified by these sudden roaring clouds from which sped unseen messengers of death, fled in confusion, followed hard by the conquering tribe. The usual scene of horrors ensued, and among the booty was a small quantity of precious metals, which was eagerly taken possession of.

"But still their hopes were unrealised. They had seen none of the warriors armed with plates of Gold, who had been described to them; still less was there any sign of the heaps of Gold and Silver, two feet high, which were to be the reward of each soldier's toils. Potanou's country was no richer than Outina's; and now the story told to them was that the mines lay beyond in the Appalachian mountains. Scarcely able to understand this appetite for Gold, which they were yet keen enough to turn to their own advantage, the Indians did not scruple on this subject to say anything which might please the French, who, for their part, were equally ready to believe anything they might be told. This is the key to much of the history of the early settlement of America, which recalls the old story of the man who on his death bed informed his sons that he had a treasure hid in a field, and thus, as he had foreseen, animated them so to dig and harrow the earth that at last it enriched them by its fertility. In as vain a search the early explorers came to gain that knowledge of the country and its capabilities, which was turned to account by their successors after they had perished in their unrewarded labours."

But it may be urged that, as modern Gold-digging has no association with such crimes, it must be regarded as a highly advantageous and fruitful pursuit. The Nemesis seems still to follow the "Gold-hunger."

"If we contrast the various countries of the world," writes Mr del Mar, "that were settled by Gold-seekers with those that were not, we shall find that if the argu-

ment *post hoc ergo propter hoc* is worth anything at all, it is in every instance to the disadvantage of the countries so settled. Contrast Lydia with Italy, Greece with Gaul or Germany, Spain with England and Mexico or South America with the eastern portion of the United States; and in every case we shall find that the Gold and Silver countries have fallen into decay, and the countries without the precious metals risen to wealth and power. . . . .

"The reason is that to obtain possession of the precious metals man has to destroy the land; and, therefore, that so far from the settlement of a mining country being a source of congratulation to mankind, it is really cause for regret, for it commits so much of the earth's surface, the scene of such settlement, to irreparable destruction. If we turn from California to Australia, we shall find a similar abandonment of previously flourishing national industries, either local or distant, for Gold-mining, and a similar enormous rise of prices near the Gold-diggings, which, while it perhaps benefited a few, could only have injured the many, since there turned out, in the end, to be no sufficient basis for it in the looked for, but illusory, profits of mining."

And again—

"Perhaps a stronger, because a more obvious, proof of the unprofitable character of Gold and Silver-mining is afforded by its inability as an industry to support a large population. California, as a mining country, has now been open thirty years; Australia about twenty-five. They are both agricultural as well as mining countries, and, therefore, comparatively easy of access. They are both agricul-

tural as well as mining countries, and, therefore, owe some of their population to other causes than the search for Gold. Yet California to-day does not contain more than three-quarters of a million of population, nor the mining colonies of Australia, viz., New South Wales, Victoria, New Zealand, and Queensland, over two millions. Any comparison of these figures with the populations supported by the purely agricultural States, which were settled at about the same time in the Mississippi Valley, and, therefore, most remote, difficult, and expensive of access, will prove the superior ability of agriculture, if not to attract at the outset, certainly to retain and permanently support, more numerous and better-bestowed communities. This conclusion applies to every great mining country in the world—to Greece, Spain, Mexico, the Western Coast of South America, and Brazil. . . . Apart from the unprofitable character of Gold and Silver-mining, which is due to the necessity of selling the product in competition with a vast accumulation of like metals stored up for ages, the superiority of agriculture over mining is due to the fact that in the former industry land can be used over and over again perpetually, while in the latter it can be used only once. Nature does not renew her deposits of the precious metals, at least, within any period that renders the increment available to man."

There thus seems to be a stern limit to the profitable extension of Gold-mining. Systematically, and on a great scale, to seek for it does not appear to be recommended either by Providence or political economy.

"Even with free mining," say Mr del Mar, "and apart from the influence of the stock, the cost of producing Gold and Silver from the mines is not, as is generally supposed, limited by their commercial value or purchasing power. The fascinating hazards of mining, and the hope cherished by each miner for himself of becoming exceptionally fortunate, sustain the pursuit far beyond the limits of prudence; and in the long run and in all countries it has been unprofitable, Gold and Silver, wherever obtained by free labour, having always cost more than they are worth."

Mr N. S. Shaler, who has said the very best that can be said in support of "precious metal mining," in an article which is full of valuable information, in *The Atlantic Monthly* for June, 1880, writes thus on the general question:—

"The quickest attained, if not the most permanent, source of national wealth is, doubtless, to be found in the development of the precious metals of a country where they exist in profitable quantities. All the other exchangeable results of labour have their value much reduced by costs of transportation, or by the state of the markets where they must be sold. If the labour yield corn or cloth, it must bear the tax of distance, the import of foreign duties, and the variation of demand; if it yield Gold beyond the cost of production, none of these drawbacks weigh upon it in an appreciable way. It is, therefore, natural and fit that, among all the resources of a new country, men should first attend to the precious metals, and that the Gold and Silver hunter should have been the

pioneer of civilisation (!)—the greed of gold, the very wind in the sails of the explorers who have broken down all the barriers of distance and difficulty that the earth sets against commerce. The nature of his work, giving, as it does, neither food, nor clothing, draws in its train all the finer elements of society, and so brings about the rapid subjugation of the wilderness. Moreover, as the explorer for Gold must combine skill, judgment and courage, with a strong body and determined will, he makes the best possible beginning for civilisation. With all his faults, he is necessarily the manliest of rough men—the fittest material to face the difficulties of a wilderness, and to lay therein the very foundation of states to be."

Mr Shaler hardly takes due note, first, of the destruction of the ground in view of immediate agricultural development; and, secondly, of the disinclination of the mining class to turn to other and more settled callings. But he says all that can be said against some of the positions we have taken; and we are glad to refer to his interesting paper. Nothing could be more succinct than his account of the process by which Gold and Silver are formed in the earth:—

"Of late years there has been a great advance towards a clear understanding of the natural processes by which metallic deposits are brought into the shape in which the miner finds them. All the old notions about the outbursts of mineral veins, by fiery ejection from the deep interior of the earth, have been cast aside. Geologists now pretty generally recognise the fact that all our metals are deposi-

ted in our stratified rocks as they are laid down on the sea-floor, having been separated from the sea-water, as a great part of all the rocks are, by the action of sea-weeds and marine animals. In this disseminated form, but in varying degrees of richness, all our metals may be said to exist in all our rocks, but in a state so diffused that nothing but the most careful analysis by concentration of a great mass of the rock would enable the chemist to recognise their presence. In the larger laboratory of nature, where work is done more patiently than man can do it, this concentration is readily accomplished. It needs only the application on a large scale, and for a long time, of the same much-heated waters the chemist uses in his processes to strip a bed of limestone of its Gold, Silver, or other ores, and to bear them to some other part of the neighbouring earth crust. In the machinery of our hot springs and geysers, we have at once the whole of the mechanism necessary to remove the metals from their original positions in the rocks, and fill fissures with the material. Recent investigations have shown that the hot springs of the Rocky Mountain region are to-day making deposits of gold-bearing vein-stones in their fissures. The rain-water passes downwards through the rocks of the hills, until it is heated in its course and compressed under the weight of the water above; restrained from passing into steam by this pressure, its heat often becomes much greater than that of boiling water, as is proved by the behaviour of the geyser. As it creeps through the rocks it takes up the metallic substances with which it comes in contact, but

as its power of holding them depends mainly upon its high temperature, the water must perforce lay them down as soon as in its upward course it has lost a large share of its heat; and this loss of temperature occurs as the water rises through the fissure towards its point of discharge. Some part of its transporting power is given to the water by the various gases it takes up in its course,—gases produced by the decomposition it brings about. These gases are held in the water by pressure, and escape as it comes to the open air, and to a great extent leave it as soon as it approaches the surface. Thus we see that there are peculiar conditions that limit not only the occurrence of Gold and Silver in rocks, but the concentration of that which is thus contained into such a shape that it may be profitably won. These conditions are, essentially, that the metal shall first be deposited in the rocks; then that more or less heated waters shall penetrate the rocks for a sufficient time to dissolve out the disseminated minerals and accumulate them in fissures.

"The degree of heat necessary to effect this work differs widely in the case of different substances. Water at the ordinary temperature will effect the concentration of lime, and give us veins of calcite or gypsum. At the same, or a very little higher temperature, we will have lead carried into fissures, or into the porous parts of rocks. Silver begins, in small quantities, to move towards the veins along with lead in waters that are but slightly thermal. Gold appears to require a higher temperature for its transportation, or at least some conditions that are rather less

often presented than those that bring about the concentration of the baser metals.

"The result of these conditions is, that the area over which we find lead ores in profitable quantities, is very much greater than that of silver-bearing rocks, and the area occupied by Silver lodes is larger than that of Gold ores,—in part, at least; for the reason that the conditions necessary to the concentration of these substances are less and less favourable in the order in which they are named. There is no doubt, also, that the aggregate amount of these substances separated from the sea differs widely, and that the amount of lead obtained by the heated waters in passing through rocks is greater than Silver, and the Silver is greater in quantity than the Gold. This latter is the most widely distributed of these metals, though the quantity present in rocks is usually very small. Almost any sea-beach or clay-bank will probably give a technical trace of Gold, at least on a little concentration; but Silver and lead are not so widely distributed in the metallic form. This more general presence of Gold is due to the fact that it is not easily oxidized, and so endures the wear of time that reduces the other ores to atoms and bears them away to the sea.

"Another noteworthy feature connected with the distribution of the precious metals is, that while they are generally found together in the same districts, their relative abundance differs very widely in different regions. As yet there have been few attempts to determine the laws fixing the respective quantities of these substances;

and it is likely that they are, to a great extent, involved in facts that have yet to be ascertained."

In a word, valuable as Gold is as a medium of exchange and for ornament and beauty, men could do without it; but men cannot do without the essentials of legitimate merchandise which it has been made to represent; and for which it is too often absolutely taken. And as we have dealt so much with historical illustration, it may not be deemed unfitting if we take leave of the subject with an anecdote:—

"Alexander the Great arrived with his victorious army before a town inhabited only by women, and prepared for the attack. The women sent him this message: 'Why dost thou wage war against us? If thou vanquishest, thou wilt have no glory, for the world will say, This great hero has conquered women. And if the battle end in our triumph, then thy shame will be greater, since thou wilt have fallen by the hand of women.' Alexander offered unto them an honourable peace, and asked for provisions. The women brought unto him Gold bread in Gold plates. 'Why,' said the king, 'do they eat Gold in this country?' 'Certainly not,' answered the shrewd women; 'but is there no bread in thy empire that thou hast come to seek bread in our land?' Then Alexander departed with his soldiers; but, before starting, he wrote these words upon the gate of that town: 'I, Alexander of Macedonia, was heedless and without prudence, until I came to this African country, and learnt wisdom from the women.'"

SEALS AND SEALSKINS.

It was thought a very extraordinary outrage on a true sentiment, when a lady some years ago at a fancy-ball, appeared in a white dress, trimmed round and round with robin red-breasts, to represent "Winter." Truly, it represented the winter of her heart; and also the cruelty which must have been done to procure her trimming so original and expressive. It was, after all, a kind of dull, dead literalism, of which only a densely vulgar mind could have been capable. For a bit of holly, with a suggestion of the bird's presence there would have been more significantly symbolic and appealed more directly to the imagination. The rage for realism found there its last condemnation. Robin red-breasts may lose some of their good character on closer acquaintance, and may be found to be pert and quarrelsome little fellows; but that is only among themselves and their very near neighbours, and in this, we fear, they only resemble the more closely those who are so very clever as to find faults in them. Their combativeness and quarrelsomeness only make their

life the more faithful "image of the mighty world." And the sentiment which condemns the immolation of robins for the purpose of fancy-ball costume is quite healthy and sound; and we trust it may long exercise its own power to deter.

But the same thing has to be said of some other products respecting which it is not so easy to stir a strong sentiment. We read sometime ago, in the newspapers, of the theft by two women of a Sealskin jacket worth £400. Did it ever strike the reader what an irony there was in the circumstance? For the jacket itself—or the material of which it was made—was stolen in defiance of all the laws of right and humanity and true economy; and, even though her ladyship, the owner, paid down the fair sum in sovereigns on the counter to the shopman where she bought it, still the taint of the theft clings to it and will cling—such a taint as should deter every lady, on her being made aware of it, from purchasing such an article of dress again—seeing that silk, or velvet, well lined with soft wool, might have suited her equally well.

How, then, is such a Sealskin jacket obtained? By inflicting intense pain and suffering on a class of the most unoffending, affectionate, and intelligent of God's creatures. We remember hearing from Mr Frank Buckland a noble appeal for the Seals, one of the most noble appeals we think man ever made; and he said that the suffering inflicted and the destruction caused in the process of Seal-hunting was simply appalling and unspeakable. Does the reader ask, Why so? seeing that Seals are simply

animals made, like other animals, for the service of man. We remember to have read in a school-book that "Seals are fishes." Fishes are cold-blooded creatures, and may be presumed to have less capacity for suffering than warm-blooded creatures. But Seals, as the school-book writer really should have known, are not fishes, but warm-blooded mammals, and that not only are they very sensitive, but in many respects surpass the dog, particularly in attachment to their offspring. Well, the £400 Sealskin jacket was the proof of uncounted robberies of young Seals from the breasts of the mothers, who have been said to throw themselves into the fishermen's boats to share the fate of the young ones, and on being thrown out, to throw themselves in again. Sealskin is of little or no value for fur save in the case of the young, and the younger the better as regards value. Only a certain portion of the skin can be used for such purposes as jacket-making, and therefore the £400 jacket must have represented a vast deal of enterprise, bravery and self-command devoted to a doubtful cause. For the Seals are very careful of their young, and guard them incessantly. They are intelligent and take cunning precautions; and the Seal-hunter must keep a clear eye and a steady hand, one single skin sometimes costs him days' stalking. In most cases the old ones are sacrificed for the sake of the young; Seal-hunting is, in part, a kind of battue. The area of Seal population is gradually lessening, retiring more and more within the Arctic area, simply because the demand for fine jackets &c., requires a kind of indiscriminate slaughter; and as

what is clearly impossible. Those persons generally fare best at his hands who, whether from simplicity or from ignorance, only ask him to do what he professes, and no more. In the matter of colour, for example, he does not undertake to render some colours, while he is remarkably successful with others. Yellow or orange may suit the brunette, and mauve, or the lighter shades of blue and grey may harmonise with the blonde; but the camera cannot reproduce them. The yellow ray of the spectrum does not affect the silver plate, whilst mauves, purples, and blues do very keenly affect it. When, therefore, the printing process reverses the shades on the Photographic plate, the yellow becomes black, and the delicate light colours print almost white. A certain class of people would like the Sun to register all their finery, regardless of these facts.

Again, as often happens in this poor world of ours, there may be too much even of a good thing. If the Sun is too strong and unrelieved, it is almost as bad for the Photographer as when he does not condescend to show his face. What is termed a good taking day, such as is favourable for printing from the negative, is by no means favourable for producing the highest specimens of the Photographic art. The full blaze of the Sun, however shaded from the camera, never yields the soft half-tones which give so much charm. Although the sitter may be in a room whose northerly aspect may wholly exclude the direct rays of the Sun, yet his penetrating influence affects the whole firmament, and the effect is, the silver of the

plate is affected so quickly in the higher lights that no time is permitted for the drawing of the half-tones, without which you have but a poor portrait. Hence it is that a slightly cloudy day yields the best pictures.

To get good Photographs, time is essential, and, of course, time is money, which means that if you want a good portrait you must go to a skilled and careful manipulator, who not only knows the scientific laws connected with Photography, but studies to attain what is suitable to every sitter, and makes the whole, colour and all the rest, to harmonise.

The Carte de Visite is often more successful than the bigger Cabinet pictures as respects likeness, because the main figure is all included in the centre of the lens; but the Cabinet picture is generally softer in the outlines, for a reason as good. The late Mr Claudet invented a process for accomplishing this, by means of a moveable lens to his camera. A very slight movement broke up the sharpness of the outline, and he thus succeeded in getting soft and most agreeable portraits. The colour, again, of the Photograph has a great deal to do with its pleasant appearance. We shall see before we have done how much special applications of electricity have done to overcome this drawback.

Several years ago, what was called the diamond cameo Photograph was brought out. Four different views of the face of the sitter were taken on one carte. The Photographer employed a small camera and small lens. A simple arrangement within the camera enabled him to ex-

pose a section only of the plate at once. This, when once it had received its impression from one portion of the sitter's head, was moved so as to receive another. The reason for masking the negative was to protect the intervening space on the slip of prepared paper from the action of the light, so that it might appear perfectly white, while the sharp ovals representing the heads were more or less dark, making a striking contrast. The plan did not, however, succeed; the sitter did not recognise his own face in some of the positions in which he could not see it in the glass.

One great step in advance has recently been made, which will affect all forms of Photography, but particularly landscape and every kind of out-of-door work. Hitherto, as most people are aware, the negative was fixed by what is called the "wet collodion process," which rendered necessary a preparation and pouring-over the plate immediately before its exposure to the object in the camera. The Photographer had, in effect, to carry a small chemist's shop with him. This he had, at the peril of loss and of failure, to keep in good order. Nowadays, however, he may feel freer at the decisive moment to devote himself to the artistic side of his work. The sensitive surface on the plate, it has recently been found, can be equally well, if not better, attained by preparations called "emulsions"—the most general constituents being bromide of silver, held in solution in collodion or gelatine. If this is poured over a plate, and allowed to dry in the dark, it will maintain its sensitiveness through any length of time, provided that it

be not in any way exposed to damp. It appears that the emulsion works as effectively on slips of paper, from which the Photographer may afterwards, if he desire it, transfer the impression to glass without any loss of effect. Practised men, indeed, declare that the surface under the emulsion is even more sensitive than that attained under the "wet collodion process;" this discovery may be regarded as supplying what is likely to be a permanent improvement in all Photographic work. As the process is almost instantaneous, its value in landscape and other subjects cannot be overrated.

In printing, too, greater permanence, as well as greater depth and delicacy, has been attained by the substitution of what is called the "carbon process" instead of salts of silver, which, up till a late date, had been found indispensable in use. Here lampblack forms the colouring matter. Other pigments also may be substituted for this, rendering the colours as desired; so that copies in colour of the subjects may be easily and inexpensively produced.

In a climate like ours where Sunlight is so uncertain, it is not to be wondered at that many efforts should have been made to procure an artificial light that would be at all times available. During recent years activity in this direction has been incessant. The lime light, and the magnesium light have been perseveringly tried, and more recently many experiments have been made with the electric light. None of these, however, were quite successful till Mr Van der Weyde, an American gentleman,

applied himself to a series of very careful experiments which has resulted in what may be called a new process. For faithfulness, complete roundness of modelling, delicate silveriness of tint, exquisite half-tones, and artistic play of light and shade, his process is so perfect that the absence of the Sun need no more be greatly missed or mourned. Daylight has no part in the work of Mr Van der Weyde's studio. He adopts no compromises. The sitter is posed—a point to which great attention is given—in the ordinary gas light; but the moment this has been accomplished, a large annular lens immediately appears in front of him, that is, between him and the camera, at such an elevation as not to hide the sitter from the lens of the camera. This lens—about forty inches in diameter—is composed of prismatic concentric rings of glass similar to that employed in lighthouses. It is backed by a truncated chamber, the interior of which is painted pure white. The carbon points of the electric light are placed inside this chamber and just behind the centre of the lens. The direct light does not fall upon the sitter, but on the white interior of the case behind the lens, the form of chamber being somewhat similar to that of a parabolic reflector. When all is ready, and the plate placed in the camera, the operator turns on the electric light. The rays emanating from the carbon points illuminate all the white chamber and it is this illumination which is condensed upon the sitter. The lighting system can be moved and adjusted at will by the operator, so that he can get a very great variety of effects. The direct action of the

artificial light, under which the lights have generally been harsh and chalky without graduation of detail, and the shadows black, definite, and untransparent, is thus entirely dispensed with; and herein lies one of the greatest triumphs of Mr Van der Weyde's process.

The despatch with which portraits can be taken by Mr Van der Weyde is very great. As instances of this, we may mention that as many as thirty-four negatives have been taken in the short space of two hours; and that on one occasion a lady who had sat when on her way to the Opera, had a proof-portrait presented to her before leaving it, the electric light being used for printing as well as for taking negatives, which, notwithstanding their clear modelling and fine tint, have not been *touched,* and require no *touching.* Some of Mr Van der Weyde's portraits are very fine, and in some points surpass the best Sun-pictures. The portraits of Prince Leopold, the Prince of Wales, the Duke of Sutherland, and the Countess Lonsdale are certainly very fine specimens of Photographic portraiture; and of the last named and of Mrs Langtry, the artist has as many as thirty different negatives. As Mr Van der Weyde understands the advantage of bringing up to a high standard every individual portrait that passes from his hands, his scale of prices is necessarily high—being £3 3s. for a dozen cabinet heads.

The *Times* has thus commented on Mr Van der Weyde's Photographic invention and its results:—

"Some two years ago Mr Van der Weyde, an American artist, whose paintings have been placed upon the line at

the Exhibition of the Royal Academy, wished to be Photographed, and he went for that purpose to the studio of a well-known London operator. He went daily for a week before there was light enough for a successful sitting, and the Photographer, in reply to Mr Van der Weyde's not unnatural murmurs, said that Americans were an inventive race, and that he had better find out a way to bottle Sunlight and bring it over. The half-jesting challenge induced him to lay aside his art and to devote himself entirely to the problem of rendering artificial light available for all Photographic purposes; and, after two years spent in experiments, he has at last been brilliantly and completely successful. In his studios, at 182 Regent-street, he now produces every evening, by artificial light, portraits which, if they have been equalled, have certainly never been surpassed. In the perfect modelling of the features, the delicacy of the lights and shadows, and the general truthfulness of the delineation, these pictures leave nothing to be desired. The light employed for this purpose is the electric beam, produced by a dynamo-electric machine worked by a gas engine in the basement of the house, and resembling in its general arrangements the Siemens light for lighthouses. The carbon points are placed in the focus of a parabolic reflector, forty inches in diameter, made of tin, which is enamelled white in the inside, and which may be roughly compared to a large bowl, the light being near the middle of the mouth of the bowl, and this being turned towards the sitter. In front of the light, so as to screen it from the sitter, is a metal disc four or five inches

in diameter; and, if this were all, the sitter, cut off from the direct rays of the beam itself, would receive parallel rays from the inner surface of the reflector. Mr Van der Weyde has found, however, his purpose is best served by convergent rays, and he obtains them by closing the mouth of the reflector with a Fresnel lens—that is to say, a convex lens built of concentric rings of prisms, which has the effect of rendering the rays convergent to a point some six feet from its surface. The whole apparatus—reflector, disc, and lens—is suspended from the ceiling by an ingenious arrangement of pulleys and counterpoises, such that the light can be made to fall upon the sitter from any point or at any angle; and the whole figure is flooded, so to speak, by a convergent beam of soft and pleasant white light, which does not trouble the eyes in the least degree, but which is of such actinic power that the pictures are taken by an exposure of only eight or ten seconds. The size of the beam is sufficient to include the whole figure in the erect posture, and also to allow a considerable amplitude of train to a lady. It is obvious that this, as well as the power of taking pictures at all hours without reference to Sun or weather, will open out an entirely new future to Photography. Mr Van der Weyde's success has not been attained without much labour, and this labour has not been without risk. In one of his experiments he was using a glass lens filled with water, when the weight of the water broke through the glass, and the inventor was so seriously wounded by falling splinters that he was disabled for two months. Undeterred by this disaster as by

his repeated failures, he persevered to the end, and with the results which we have described. As far as can be foreseen the reflector seems likely to have many other uses, and to admit of being applied to other kinds of artificial light. Mr Van der Weyde thinks that one of its future uses will be the lighting of places, such as the operating rooms of hospitals, where surgical operations of emergency may be performed at night; and with a generosity which is doubtless suggested by experience, he has specially exempted this mode of employing his invention from the operation of his patent, so that for surgical purposes it is free to the whole world. He served with much distinction during the American Civil War, and was four times wounded in action, so that his sympathy with the victims of surgery is not surprising. The illumination of microscopic objects seems another promising field for his reflector, since the light afforded is almost identical in quality with that of a white cloud, and can be increased or diminished in intensity at pleasure. In course of time, other applications will not fail to suggest themselves; but, in the meanwhile, Mr Van der Weyde has redeemed Photography from the reproach of being dependent upon the presence or the variations of Sunlight, and is nightly producing pictures of which not the least remarkable characteristic is the uniformity of their excellence."

Some of the more recent uses of Photography are very curious and very interesting. The application of Photography to the microscope has opened up a new world of wonders. Every one knows how the system of photograph-

ing criminals has led to some of the most remarkable identifications and detections of escaped prisoners. The ticket-of-leave system is based on Photography, we may almost say. The criminal has his portrait taken when he enters prison; he has it taken again when he leaves prison; and copies of this portrait are deposited at the police-offices near to which he locates himself, and at which he must periodically report himself, or forfeit his ticket-of-leave. We have had the opportunity to examine several of these peculiar prison records. The first thing that strikes one is the great variety of brain-development, of feature and of expression. Many have the inevitable and inherited mark of the criminal class; others are as remarkable for having nothing of it; but, whether or not, the portrait is taken, filed and distributed, and another guarantee given of safety to society against systematic depredations upon it.

CLOCKS AND WATCHES.

Mr Emerson has quaintly remarked that the penalty the City-man pays for the keyless gold repeater in his pocket is, that he has lost the simple faculty, which the wildest savage possesses, of reading the time by the sun. If, as Mr Darwin holds, there is degeneration as well as advancement, in the transmission of powers and qualities from generation to generation, it is indisputable that the presence of the gold repeater is responsible for a good deal in human experience. History truly repeats itself here as elsewhere. The very latest improvements in our keyless watches and chronometers—the striking of the hour, the quarters, and even the minutes, on the setting of a certain spring, so as to overcome the difficulty of "seeing the time" in the dark, are but re-expressions and frank recognitions of a difficulty which beset the very earliest efforts of the inventors of systematic time-measurers. Alfred the Great is credited with the first endeavour in this country to measure time by night when the sun-dial was necessarily unavailable. He marked his time by the

constant burning of wax torches or candles, which were made precisely of the same weight and size, and notched in the stem at regular distances. These candles were twelve inches long; six of them or seventy-two inches of wax, were consumed in twenty-four hours, or 1440 minutes, and thus supposing the notches at intervals of an inch, one inch would mark the lapse of twenty minutes. It appears that these time-candles were placed under the special charge of his mass-priests or chaplains. But it was soon discovered that sometimes the wind rushing in through the windows and doors, and the numerous chinks in the walls of the palace, consumed the wax in a rapid and irregular manner. Alfred went skillfully to work, and having found out that white horn could be rendered transparent, like glass, he made a case for his candle, which kept it from wasting and flaring.

Probably, it is to the old practice of measuring the lapse of time by a candle thus proportioned, that Macbeth refers in his famous speech:—

> "*Out out, brief candle!*
> Life's but a walking shadow, a poor player,
> That struts and frets his hour upon the stage,
> And then is heard no more: it is a tale
> Told by an idiot, full of sound and fury
> Signifying nothing."

Which is all the more noticeable in one respect since Shakespere often shows a peculiar disregard of anachronisms.

The principle of the sun-dial is simple, and it is not to be wondered at that it should be found to have been in use among all civilised peoples in very early times. If a person

were to place a staff in the ground so as to point either vertically or otherwise, and to watch its shadow at the same hour on different days at some interval from each other, marking its direction at each day's observation, he would, in all probability, find that the direction of the shadow, the hour being always the same, varied from day to day. He might, however, find that the shadow was always in one direction at the same hour, and this might happen in two different ways. First, he might by accident fix the staff in a direction parallel to that of the earth's axis, in which case the direction of the shadow would always be the same at the same hour. Secondly, having fixed the staff in a position not parallel to the axis of the earth, he might happen to choose that particular hour, or interval between two hours, at which the shadow of a staff in that one direction always points one way. But if, as is most likely, he were to fix the staff in a direction which is not that of the earth's axis; and if, as is again most likely, he were to choose any time of observation but one, the shadow would certainly point in different directions at different periods.

Now a sun-dial consists of two parts—the gnomon (represented by our supposed staff), usually supplied by the edge of a plate of metal, always made parallel to the earth's axis, and therefore pointing towards the north; and the dial which is another plate of metal, horizontal or not, on which are marked the directions of the shadows for the several hours, their halves and quarters, and sometimes smaller subdivisions.

But the shadows of the gnomon are not sufficiently well defined to give very accurate results, even for ordinary purposes; refraction always makes the sun appear a little too high, and throws the shadow a trifle towards noon at all times—that is, makes the time too fast in the morning and too slow in the evening. A correction is, therefore, always necessary in order to find mean or civil time.

Sand and water have both played an important part as time-measurers. The principle of the sand or hour-glass is simple, and, in strictness, the *Clepsydra*, or Water-Clock, is identical with it. The orifice of a vessel was so made as only to allow the water to pass through drop by drop, and thus the time was measured by the quantity transferred from the upper vessel to the lower. This instrument was in use among the early Chaldeans and Egyptians. It was used in the courts of justice in Athens. It was adopted in Rome, as we read, in the third consulship of Pompey. From Greek and Roman remains we learn that the water which fell drop by drop from the orifice of one vessel into another, floated a body of some light substance, which immediately marked to the eye the height of the water as it rose. This instrument inevitably demanded great care and constant regulation, as well as skill and experience in calculating; because it is clear that the first half of the contents of the upper vessel would be sooner discharged than would the remainder. This is a point which anyone can test for himself by keeping such a vessel full and then allowing it to empty itself and noting the difference of time it takes.

Dom Charles Vailly, a Benedictine monk, is said to have first improved the Water-Clock into a scientific instrument about 1690. This instrument was formed of tin, and consisted of a cylinder divided into several small cells, and suspended by a thread fixed to its axis, in a frame on which the hour distances, found by trials, were marked. As the water flowed from one cell into the other, it very slowly changed the centre of gravity of the cylinder, and put it in motion so as to indicate the time on the frame. By later improvements, an alarum, consisting of a bell and small wheels, was fixed to the top of the frame in which the cylinder was suspended, and afterwards a dial-plate with a handle was also placed over the frame; the advantages of our common Clock were thus, in some measure, obtained.

The term *horologe,* by which Clocks only came in process of time to be denoted, was formerly applied indiscriminately to dials and Clocks, so that nothing decisive as to the era of invention can be inferred from its use. The first author who has introduced the term as applicable to a Clock that struck the hour, is believed to have been Dante, who was born in 1295, and died in 1321. In Italy, however, it would appear that striking Clocks, moved by weights, were known in the latter part of the twelfth century. England was in possession of these improved time-meters at rather a later period. In 1288, in the time of Edward I., a fine imposed on the Chief Justice of the King's Bench, was applied to the purpose of furnishing a Clock for the Clock-house near Westminster-hall, which

Clock was to be heard by the courts of law. This Clock was considered of such consequence in the reign of Henry VI. (which commenced in 1422), that the king gave the keeping of it, with the appurtenances, to William Warby, dean of St. Stephen's, together with sixpence per day, to be received at the Exchequer. The Clock at St. Mary's, at Oxford, was also furnished, in 1523, out of fines imposed on the students of the University. Mention is made in Rymer's "Fœdera," of protection being given by Edward III. to three Dutch horologers, who were invited from Delft into England in the year 1368; and we find in Chaucer, who was born in 1328, and died in 1400, the following lines:—

> "Full sickerer was his crowing in his loge,
> As is a *clock*, or any abbey orloge."

Towards the middle of the fourteenth century, the famous Strasbourg Clock was erected in the cathedral of that city. It was a complicated piece of mechanism, the plate exhibiting a celestial globe with the motions of the sun, moon, earth, and planets, and the various phases of the moon, together with a perpetual almanack on which the day of the month was pointed out by a statue; the first quarter of the hour was struck by a child with an apple, the second by a youth with an arrow, the third by a man with the tip of his staff, and the last quarter by an old man with his crutch. The hour itself was struck on a bell by a figure representing an angel, who opened a door and saluted the Virgin Mary: near to the first angel stood a second, who had an hour-glass, which he turned as soon

as the hour had finished striking. In addition to these was the figure of a golden cock, which, on the arrival of every successive hour, flapped its wings, stretched forth its neck, and crowed twice. Bennett's famous Clock in Cheapside seems after all, to be only a simple, sectional, and far-off copy of this ancient piece of mechanism and symbolism. Two hundred years later this celebrated Clock at Strasbourg, was almost entirely renewed, when great alterations in the original mechanism were made. At present we believe it has fallen quite into disuse. A Clock also with a very complicated machinery, though differing considerably in its external performances, was erected, somewhere about the year 1385, in the Cathedral of Lyons.

The next important Clock of which we have any description was regulated by a balance; it was the work of Henry de Wyck, a German mechanician of considerable ingenuity, and was placed in the tower of a palace of the Emperor Charles V., about the year 1364. This Clock of De Wyck, and indeed all those made with a balance for the regulator, without any regulating spring, must have been very imperfect machines, yet our present Clocks and Watches are but improvements upon this rude beginning. At what period portable Clocks were first made is uncertain; but there is a curious story told of a gentleman of the court of Louis XI. of France, which, if true, shows they were then in vogue. After having lost a large amount of money at play, this courtier stole a Clock belonging to the king, and hid it in his sleeve. The Clock, neverthe-

less, continued its movements, and after a time gave notice of its presence by striking the hour. The theft was thus discovered, but the king, capricious in his kindness as in his cruelties, forgave the offender and actually made him a present of the Clock. In the year 1544, the Corporation of Master Clockmakers at Paris obtained from Francis I. a statute in their favour, forbidding any one who was not an admitted master to make Clocks, Watches, or alarums, large or small. Before portable Clocks could be made, the substitution of the main-spring for a weight, as the moving power, must have taken place.

The application of a pendulum to the Clock marked another era in construction. Galileo and Huygens contended for the priority of the pendulum to Clocks; but the honour really belongs to a London artist named Richard Harris, who invented and made a long-pendulum Clock in 1641, seventeen years before the date at which Galileo describes himself to have made or directed the making of one.

In 1617, Barlow, a London Clock-maker, invented the repeating mechanism by which the hour last struck may be known by pulling a string; but a much more important addition to the improvements in Clocks speedily followed, namely, the invention of the anchor escapement, which, like most others that have stood the test of time, belongs to the English. This was the work of Clement, a London Clockmaker, in 1680.

It would be a matter of some difficulty to determine what artist first reduced the portable Spring-Clock to the

dimensions of a Watch to be worn in the pocket. The small Clocks prior to the time of Huygens and Hooke were very imperfect machines; they did not even profess to subdivide the hours into minutes and seconds until the invention of the balance-spring, which is to the balance what gravity is to the pendulum, and its introduction has contributed as much to the improvement of Watches as did that of the pendulum to Clocks. The honour of this invention was warmly contested by the last-named individuals previous to 1658; but, so far as priority of publication is concerned, the honour is due to Hooke.

Towards the end of the last century a Clock was constructed by a German mechanic named Droz, capable of performing a variety of surprising movements, which were effected by the figures of a negro, a shepherd, and a dog. When the Clock struck, the shepherd played six tunes on his flute, and the dog approached and fawned upon him. The Clock was exhibited to the king of Spain, who was highly delighted with the ingenuity of the artist. The king, at the request of Droz, took an apple from the shepherd's basket, when the dog started up and barked so loudly, that the king's dog, which was in the same room, began to bark also.

There is a great deal of interest in the Swiss Clock-making. The wheels are first stamped, and then accurately cut out by machinery; and, before America had, as we shall see, developed the system of Clock and Watch-making, which now threatens to supersede hand-work pretty generally throughout the world for all but the

very finest Watches, the Swiss Clock-makers had made a considerable start in that direction. Among the Schwartzwalders too, great progress has been made, such progress indeed as still enables a good deal of their product to pass for something else than it really is—suggesting once more the Shakesperian axiom—"What's in a name?" Clock-making is in fact a leading industry in the Black Forest of Germany; and Miss Sèguin in her admirable book on the Black Forest gives a very interesting account of it; from which we extract a few sentences:

"One of the very earliest, if not the first, Black Forest Clock is exhibited in the Industrial Müseum at Furtwangen. It is two hundred and eleven years old. It only shows the hours, and has to be wound twice in the twenty-four. Its works consist of three wheels, regulated by a balance, to which a string with a great stone, as weight, is attached.

"An improvement was very quickly made upon this simple mechanism.

"The pendulum was introduced about the year 1740, the application of the pendulum to the movement of the Clock having, it is believed, been first suggested by Galileo. Striking Clocks were invented also about the middle of the eighteenth century. These at first had to be wound every twenty-four hours. Eight-day Clocks were not manufactured until some forty years later.

"In the year 1850 a great spur was given to this industry, which it was found had begun to decline, by the establishment of a Clock-making school at Furtwangen.

"An attempt was also made to introduce the manufacture of Watches, but this does not seem to have been attended with any great success, and the chief product of the district still continues to be the wooden-cased varieties of time-pieces, which, under the name of Dutch and American Clocks, have found their way into almost every household in England.

"It is curious, that what we know as Dutch Clocks are known on the Continent as German, and that what we know as American are called by the German makers Scotch—probably, it is thought, from some Scotch workman having first been employed in making them.

"Formerly, and until within the last fifteen years, every portion of the works of these Black Forest Clocks was made by hand, and each workman began and finished his own Clock in his own cottage, being assisted in his labours by the different members of his family. Now, this hand and individual labour is, to a great extent, done away with, being supplemented by large establishments, where a hundred or more men are engaged, in which machinery is employed, and the labour is subdivided into at least a dozen processes. The men work twelve hours, are paid from a shilling to half-a-crown a day, and women are employed as polishers of the cases.

"The old hand-labour system is maintained only in a few remote villages, and for the inferior kinds of Clock.

"Since the introduction of machinery the Black Forest Clocks have been, it is said, not only cheaper but more accurate, although it is certain that some of the old

wooden Clocks, made a hundred years ago, are still in use, having withstood the various changes of temperature, and the wear and tear of a century, with scarcely any diminution of their powers.

"One peculiarity of the Black Forest Clocks is, that they are almost all made to be fastened against a wall, not as chimney time-pieces, and thus they are used throughout Germany, where, in truth, it would be difficult to find a place for time-pieces, as chimneys do not exist there.

"The favourite form is the cuckoo-clock, and a variety of other mechanism is also introduced in the more elaborate specimens. It would be difficult, indeed, to say that any result was impossible to the inventive genius of these Black Forest Clock-work makers.

"In the ninety-two parishes which form what is called the Clock-country, are over 1400 master Clock-makers, who employ some 6000 workmen. Altogether, about 14,000 people, including women and children, are occupied by this one industry. The number of Clocks manufactured yearly in this district is calculated at two millions, valued roughly at one million sterling."

In America the mechanical process of Watch-making has been carrred to the highest perfection, to such a pitch of perfection that some have hazarded the opinion that the English makers—unless they very much modify their practice—will now find it hard to compete with them. That is not our opinion; because in the very highest class of Watches hand-work is admitted to be for much essential. The American process, however, is so interesting in its

various departments that we are fain to extract here some passages from an admirable paper descriptive of a visit paid to one of the great factories of the United States by Miss Emily Faithfull, whose concern in all that bears upon the industrial employment of women is so untiring, and has been so beneficial. She will no doubt gladly allow us to make use of these passages, as we ourselves have not been in America:—

"The works of a Watch, not counting the plates which form the shell or frame, are of brass and steel in nearly equal proportions. Great sheets of brass and steel are first received in the punching-room, where an enormous pair of shears cuts them into ribbons. These are lengthened, and thinned between a pair of steel rollers, which, if required, will leave them only one four-thousandth part of an inch thick. One of these ribbons is then passed slowly between the punch and die of a huge press, driven by a heavy wheel which a workman controls with his foot. The punch rises and falls with the motion of the wheel, coming down each time with a weight of twenty tons, and, with a 'click,' cutting out a perfect spoked wheel. The press is an enormous monster, which bites out mouthfuls of steel, but refuses to digest them. Like most monsters, however, it will do no damage if it is only fed. It leaves the wheels fast in the strip to be knocked out by hand. With a man it can cut out ten thousand wheels in a single day.

"Next we visit the plate-room. The upper and lower brass plates are respectively the roof and floor of the

Watch. The upper one must have thirty-one holes bored in it, for pillars, pivots, and screws. A little girl cuts them with a needle-like drill, which revolves like lightning, and goes through the thick plate in a twinkling. Another girl, with a chisel, whirling with equal rapidity, cuts away the ragged burs or edges left on the side when the drill comes out. This "countersinking" which leaves a cup-like depression, is performed wherever a hole is drilled through brass or jewel. The four pillars—the posts which are to bind roof and floor together—are made and inserted in the lower plate, by a miraculous little contrivance, which a coffee saucer would cover. The punching machine is a behemoth, but this is a fairy. It seizes one end of a brass wire, and in eleven seconds measures off a pillar, turns it down to the required size, makes a screw-thread in each end, cuts it off, and screws one end into the plate so firmly that we cannot unscrew it with a pair of pincers. But it keeps the workman's feet busy and his hands flying, as if he played a lively tune upon the piano. He will easily make and insert two thousand pillars in a day. By hand, he could hardly make two dozen.

"When the brass pieces are finished, all belonging to one Watch are stamped with the same number, and put into one of ten boxes, hollowed out in a board, like birds' nests, The nests have yet many journeys to make before the eggs are hatched; but the shell or frame is now ready for the works.

"The upper plate is next engraved. Three men and

four girls are kept busy tracing the elaborate scroll work, &c., but the numbering runs consecutively through all.

"The screws in a Watch number forty-four, or more than one quarter of all its pieces. The screw and steel department is one of the largest in the factory. Its magical little automata, run by nimble-fingered girls, convert shining steel wire into infinitesimal screws, pare down their heads, and cut slots in them for microscopic screw-drivers. They are polished to perfect smoothness and then, like every other part of the Watch, brought to 'spring temper'—the temper of the sword-blade—by heating, which leaves them of a deep rich blue.

"There are machines which will cut screws with five hundred threads to the inch; the finest used in the Watch have two hundred and fifty. Even these threads are invisible to the naked eye, and it takes one hundred and forty-four thousand of the screws to weigh a pound. A pound of them is worth six pounds of pure gold. Lay one upon a piece of white paper, and it looks like the tiniest steel filing. Only by placing it under a strong magnifier, can we detect its thread, and see that it is shining as a mirror, and as true and perfect as the driving-wheel of a locomotive.

"Screws for the best compensation-balance are of gold. A ten-dollar piece will furnish material for six hundred and fifty of them. The compensation-balance comes from the punching-room, a solid piece of steel as large and heavy as a new penny, and enclosed in a rim of brass. It is ground down, worked out, and polished until it becomes a slender

wheel—the outer rim brass, the inner rim and cross-bar steel—lighter and thinner than a finger-ring. Through the double rim, twenty-two holes are drilled for the screws. A chuck whirls the wheel round—as one would spin a penny upon the table—four thousand eight hundred times a minute, while a lad makes each hole by applying three tiny drills, the one after the other. He will bore one hundred wheels per day, or apply a drill oftener than once in six seconds, from morning till night—to say nothing of the time consumed in fastening on and taking off the wheels and sharpening his drills. Screws of gold or brass are then put in, and the balance is completed. On this little part alone, nearly eighty operations have been performed.

"Next we step into the train-room, the largest and pleasantest in the factory. Seventy-five persons, with busy fingers, sit at six rows of benches extending its entire length, each before some little machine, shaping, smoothing, pointing, grinding wheels, pinions, or pivots.

"Cutting teeth in the wheels is done by piling up twenty or more, with an upright shaft passing through the centre of each, and turning a screw to hold them together. The girl in charge then lifts one handle of a little machine and instantly a steel cutter like a shingle-nail, but with a sharp point at one end, is brought against them, whirling so fast that it looks like a perfect wheel. Whizzing down the outer edge of the pile, it cuts a groove or furrow in each wheel. When it reaches the bottom the girl moves the other handle; the cutter flies to the top, and runs whizzing down again. A single wheel has from sixty to eighty

teeth, but the girl will finish twelve hundred wheels a day. The long hooked teeth of the scape-wheel, and the horn-shaped tooth of the ratchet, are cut with equal facility.

"In the escapement and jewellery departments we first encounter precious stones, in which pivots of brass or steel will run for generations without any perceptible wearing. In the order of hardness they stand:—diamond, sapphire, white or milky ruby, red ruby, garnet, aquamarina. In jewellery they are valued for their colour, in Watchmaking, only for their hardness. . . .

"Every part of a Watch must be absolutely accurate, but no part must fit perfectly. To run freely, each pivot must have a little play, like a horse in harness; otherwise the least bit of dirt or expansion of metal would stop the delicate machinery. So every jewel-hole is left a little larger than the pivot which is to revolve in it, for the 'side-shake,' and every shaft or axle, a little short for the 'end-shake.' The tiny gauges which measure all the parts make allowance for this—a bit of calculation which they perform with an ease and accuracy unknown to poor human brains.

"There is another danger to guard against. If the least grain of diamond-dust is left in a pivot-hole it will imbed itself firmly in the steel pivot, and then act as a chisel, cutting away the jewel every time the pivot revolves. The new dust of ruby or garnet which this produces will act in the same way—'diamond cut diamond'—until the jewel is utterly ruined; so the utmost care is necessary to see that no particle of diamond-dust remains in the Watch.

"After the jewellery is done the birds' nest boxes go to the finishing-room. In following, let us glance at the dial department.

"The dial, a plain circle-plate of Lake Superior copper, no thicker than a silver three-cent piece, is first covered with a paste of fine white enamel, carefully spread on with a knife, to the thickness of three one-hundredths of an inch. After it dries a little, a workman with a pair of tongs places the dial flat upon a red-hot iron-plate, in the mouth of a glowing furnace, watching it closely and frequently turning it. The copper would melt but for the protecting enamel, and, at the end of a minute, when he takes it out, it is as soft and plastic as molasses candy. The baking has 'set' the enamel, but has left it rough, as if the dial-face were marked with small-pox. After cooling, it is ground smooth upon sandstone and emery, and then baked again.

"Now it is ready for the painters. A girl draws six lines across its surface with a lead pencil guided by a ruler, making each point for the hours. Another, with a pencil of black enamel, traces coarsely the Roman letters from I. to XII. A third finishes them at the ends, to make them symmetrical. A fourth puts in the minute marks. Then the dial goes to an artist, who, holding it under a magnifier, paints the words 'NATIONAL WATCH COMPANY' in black enamel, with a fine camel's hair brush. . . .

"In the finishing-room we find a drawer full of mainsprings, coiled so loosely that each is as large as a breakfast saucer. One drawn out straight will be two feet long.

It is polished like a mirror, and tempered to a beautiful deep blue. A girl coils one to the diameter of a thimble, and then, rifling one of the birds' nests, inserts the main-spring in its brass 'barrel,' the head of which is held in by a groove like the head of a flour barrel. This circular chamber, only seven-tenths of an inch across, contains the whole power of the Watch. One end of the main-spring is fast to the shaft which passes through it, and by which it is turned; the other, as it uncoils, carries round the barrel, and so communicates motion to the train. She puts the parts together temporarily, inserting only screws enough to keep them in place. Her flying fingers set up ninety Watches, and empty ninety birds' nests every day. The latter go back to the plate-room for more eggs and fresh incubations: here, at least, there are always birds in last year's nests.

"Hair-springs are made in the factory, of finest English steel, which comes upon spools like thread. To the naked eye it is as round as a hair, but under the microscope, it becomes a flat steel ribbon. This ribbon is inserted between the jaws of a fine gauge, and the dial-hand shows its diameter to be two twenty-five-hundredths of an inch. A hair plucked from a man's head measures three twenty-five-hundredths, one from the head of a little girl at a neighbouring bench, two twenty-five-hundredths. Actually, however, the finest hair is twice as thick as the steel ribbon, for the hair compresses one-half between the metallic jaws of the gauge.

"A hair-spring weighs only one-fifteen-thousandth of a

pound troy. In a straight line it is a foot long. With a pair of tweezers, we draw one out in spiral form until it is six inches long; but it springs back into place, not bent a particle from its true coiling. It must be exquisitely tempered, for it is to spring back and forward eighteen thousand times an hour, perhaps for several generations. A pound of steel in the bar may cost one dollar: in hair-springs it is worth four thousand dollars.

"After the Watch has been run a few hours, to adjust the length of the hair-spring, it is 'taken down,' and all the brass pieces sent to the gilding-room. There each part is polished for electro-gilding. Gold coin is first rolled out into sheets, and then dissolved with acids. At some stages it looks like nauseating medicine, but when it goes into the battery, the solution is as colourless as spring-water. But it is deadly poison. A girl in this room was kept at home for three weeks, with sores upon her hand, caused by dipping it in the liquid.

"Twenty or thirty of the brass plates and wheels are hung up by a copper wire in the inner vessel or porous cell of a galvanic battery, filled with this solution, and the silent electric current deposits the gold evenly upon their surfaces. Ordinarily they are left in it about six minutes: the quick, educated eye of the superintendent determines how long. A twenty-dollar gold piece will furnish him with gilding for six hundred Watches, but he could make it gild four thouaand, so that they would look equally well on first coming out; or he could put five hundred dollars on a single one—leaving the gold an inch thick all over

the works—and it would look no better. All the pieces come out clothed in yellow, shining gold, and are sent back to the finishing-room, put together again, and then turned over to the "Watchmakers"—the only persons in the factory necessarily familiar with all parts of the Watch. A dozen sit in a row, in a very strong light, before a long bench strewn with minute brushes, tweezers, magnifiers, and glass cases, which cover small mountains of wheels and pinions. They insert the balances and hair-springs, see that every thing has been properly fitted, and put in the dial.

"Then the Watches, each in a little circular tin case, go in boxes of tin to the lynx-eyed inspector, who scrutinises every part for the slightest flaw or defect. Here is a box which has passed through his hands. Upon two Watches are little slips of paper, one labelled 'Fork strikes potance' —a slight but needless friction; the other, 'Fix the number'—the figures upon one piece being wrong or illegible. About one third are thus sent back to the 'Watchmakers' after his rigid examination.

"The last scene of all is the adjusting. In his quiet little room the adjuster keeps the Equator and the North Pole always on hand, and ready for use in large or small quantities. First, he runs the Watch eight hours in a little box heated by a spirit lamp to one hundred and ten degrees Fahrenheit. Then he runs it eight hours in a refrigerator, where the temperature is nearly at Zero. It must keep time exactly alike under these two conditions. If he finds any variation, he changes the position of the

screws in the compensation-balance or substitutes new ones, first carefully weighing them in a pair of tiny scales of his own contriving. When we ask him to show us the minutest weight they will indicate, he places a bit of whisker upon one end, and adjusts the weight. The speck of hair weighs a trifle over the fifty-seven millionth of a pound troy.

"The Watch is next carefully adjusted to keep time in different positions. Then it is ready for the case. The different parts are composed of one hundred and fifty-six pieces. The old Watch made by hand, contained eight hundred pieces, if we count every link of its chain as a separate part. Reducing the number four-fifths, has correspondingly reduced its intricacy, friction, and difficulties of repairing."

LOCKS AND SAFES.

PROPERTY, or the symbols by which it is represented, would lose half the attraction were it not for the sense of secure possession. The man who makes two blades of grass to grow where only one grew before, is rightly accounted worthy of honour; and we may well think with reverence of the man who first caught a wild horse by the mane, put a leather thong over its neck and then forced a bit into its mouth, and made it obediently serve him. But almost equal honour is due to the unknown benefactor of society in all time coming who first discovered how a heavy bolt could be moved and put in such a position as to close fast a door or a lid by means of an instrument which could be easily carried about; for he was the first inventor proper of the Lock and key, which now in their later scientific refinements do so much to guard and make secure, to enable us to keep watch and ward as effectually when absent as when present.

The archæological associations of Locks and keys might furnish matter for volumes, and indeed volumes have been

written on the subject. To bear the key on the shoulder was a symbol of power and authority throughout the East in early times. This practice is thus alluded to in the Book of Isaiah: "The key of the House of Israel will I lay upon his shoulder." And it is certainly remarkable that the word for key in this passage, מפתח (muftah), is the same still in use all over the East. The key of an ordinary house in these times was commonly thirteen or fourteen inches long; the key of the gate of a public building, or of a street, or quarter of a town, was two feet and more in length.*

Eastern Merchant bearing his Keys on his shoulder.

Keys, too, in the shape of a sickle, very convenient in form for carrying on the shoulder, were common in the East and in Greece. Afterwards they were more elegantly made with ivory handles, and were regarded as ornaments.

* "Price on Locks and Keys," p. 182.

It is evident that it was this class of key which Penelope is represented by Homer (Odyssey xxi.) as taking to open a wardrobe—"a brass key, very crooked, hafted with ivory." Eustathius remarks that this key was very ancient, but was still in use in his time. Ariston, the Greek poet, in his Anthologia, Book vii., applies to a key the epithet βαθυκαμπη—*i.e.*, one that is much bent. Callimachus, in his hymn to Ceres, says that the Goddess, having assumed the form of Nicippe, her priestess carried a key, κατωμαδίαν—that is, *superhumeralim*, "fit to be borne on the shoulder."

These crooked keys were most probably used to fasten or unfasten a simple horizontal wooden bar, moving into and out of a staple on the door-posts, at some distance below the bars, and then turned to the right or left by its handle.*

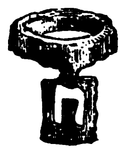
The remains of old keys found at Herculaneum abundantly prove that a kind of warded Lock must have been in use among the ancient Romans; and further proof on this point is yielded by the ancient keys now and then dug up in parts of England, and belonging to the period of the Roman occupation.

While the Romans made the keys of bronze, the Locks were formed of iron, which accounts for the decay of the latter, and for the fact that our ideas of the Locks are derived from the keys, some of which were not only finely formed, but fitted for ornaments. The Roman key has

* Price, pp. 183-4.

generally a handle in the form of a ring, occasionally of a loop, and its general construction is remarkable for neatness and strength. In many specimens the stem was so short and entwined in such a way that the ring could be worn on the finger, as will be seen by the little engraving underneath.

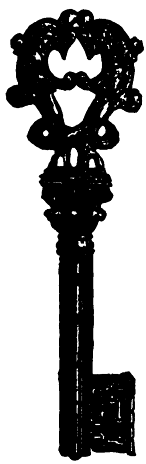
The Locks and keys of the Middle Ages are not only preserved in many examples, but are to be found depicted in suggestive emblem in missal and tapestry, or in elaborate carvings. Design was carefully studied, and great attention paid to hand-work, each part being diligently worked upon.



Roman Key-ring.

In the fifteenth and sixteenth centuries the blossoming of art made itself distinctly felt in the sphere of the Locksmith, who found in the then active armourer a formidable rival, alike in design and workmanship. And the great architects and builders of these days were not above paying attention to what might be named minor matters, devoting themselves to designing Locks for the structures they built, and grudging not to spend days and nights to attain perfection. The Locks and keys of these times reflected the revived atmosphere of art. The Locksmiths were more intent on outside decoration and symmetry than on inventing new principles of mechanism for greater security against lock-pickers. Beauty of ornamentation was the great end, and they attained it. In many of these keys the stem really becomes a Corinthian column with capital, surmounted by classical designs in the shape of dolphins,

mermaids, syrens, or griffins, placed back to back, with wings or tails interlaced to form the handle.*



In the seventeenth and eighteenth centuries the general decadence of art is seen in the making of Locks and keys; designs even became poor, artificial, and conventional. And this, notwithstanding that invention had been busy, and had not passed over Locks and keys without touching them with its own lustre. Aristocratic inventors, like the Marquis of Worcester, had not forgotten Locks and keys, and, later, royalty itself condescended to add a halo to their history. Louis the Sixteenth of France—unfortunate Louis—had a passion for Lockmaking, and used to be welcomed to a more elegant apartment than that he worked in with the words: "Ah, voila, mon dieu Vulcan!" Historians have often wondered at such a royal preference. The cares of State had hardly the attraction for Louis that the manipulation of bolts and bars had; and some have even been inclined to detect therein an omen of the future evils that broke on the kingdom of France. However this may be, a little attention to the subject subdues the first surprise that a king should be a Lock-maker, any more than that he should be a sportsman or an author, or that

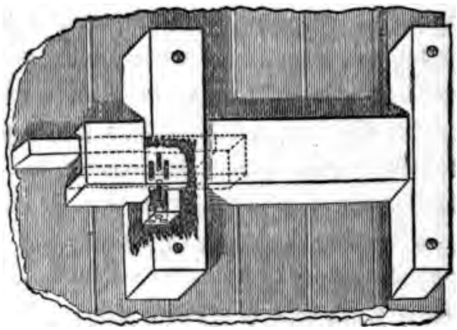
* T. W. Greene in *Magazine of Art*, for November, 1879, pp. 17-18.

princes and heirs-apparent should enrol themselves haberdashers, turners, or fishmongers. The topic is intensely interesting, and the practical work of Lock-making is sufficient to exercise the utmost mechanical ingenuity. The matter, too, should have a special interest for the social philosopher, and for the scientific student of human progress; for the keys and Locks of a people might be taken to indicate their general attainments, and to tell of the simple or the complex conditions of their civilisation. It has, for instance, been very significantly said that the French people in their Locks and Safes have more regard to prettiness of finish than to solidity; that few of their productions would successfully resist the persevering attacks of the most skilful English thieves; and that the Americans, again, tend to complicate their work, and thus to defeat their purpose.

Locks, even in their earliest forms, are symbols plainly witnessing that the idea of property has already an alien power to contend against—that with the birth of civilisation begins a civil war—chronic, determined, inevitable. As ingenuity is shown on the one side, it is sooner or later outstripped on the other; so that along with the attractive record of mechanical ingenuity and improvement, we have also in the history of Locks and keys something of the excitement of a battle between contending armies.

And yet, in one sense, it is lucky for us that the modern refinements of Lock-making come within a very recent period. Up to the latter half of last century we had hardly reached to the excellence of the Locks that were in

use in Egypt and China thousands of years ago, and have now for a very long period run in the line of re-discovery or re-application of what had been tested so long ago in



Egyptian Lock.

them. The essential principle of the Egyptian Lock was moveable pins or nails dropping, each independently, by its own weight, into the bolt, and securing it on being touched at the right point by corresponding pins at the end of the true key, all of them requiring to be raised together to the proper height. The very latest ideas in Lock-making may be regarded as suggestions or applications of this principle. One of the most noticeable and curious of these is the useful and popular Yale Lock in America, where the endless variations are attained by differing elevations on the edge of a small steel plate, with a handle as per cut. The various points act on pins which, being in succession raised to the proper level, relieve the bolt. This Lock is

Key of Yale Lock.

found of the utmost utility in the great letter-box corridor of the Post Office in the city of New York; the small pigeon-hole repositories allowing only a very small Lock, which this principle highly favours. A glance from this to the key of the ancient Egyptian Lock will show the identity of principle.

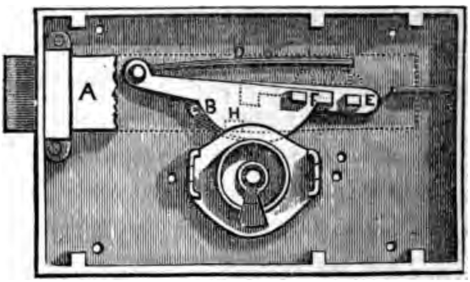
Key of Egyptian Lock.

In a letter by Sir Walter C. Trevelyan, which appeared in the *Journal of Design and Manufactures* for July, 1850, p. 160, we read :—

"It is remarkable that the Locks which have been in use in the Faroe Islands, probably for centuries, are identical in their construction with the Egyptian. They are, Lock and key, in all their parts made of wood; and are so identical with the Egyptian in structure and appearance that it would not be easy to distinguish one from the other."

The year 1640 had seen the manufacture of the first detector Lock—a mere curiosity apparently—of which the Marquis of Worcester in his 'Centurie of Inventions' says: "This Lock is so constructed that if a stranger attempt to open it, it catches his hand as a trap catches a fox, though so far from maiming him for life, yet so far marketh him that if suspected he might easily be detected." This, however, was clearly something different from the later invention of an additional lever lying over the tumblers and locking fast on the bolt if any of them are lifted too high.

Before the appearance of Mr Barron with his famous Lock in 1774, the Locks generally used in England were simply bolts which, whether shut or open, were held in position by a spring that pressed them down and held them at either end of a convex notch. The only obstructions to the driving back of the bolt were the wards, and these could easily be discovered by the insertion of a skeleton key covered with wax. To pick these locks, therefore, was easy. But Mr Barron began a new era. He not only



Barron's Lock.

produced a great improvement on the Locks in use, but he suggested further invention. The great point in his Lock was the introduction of what is called the "overlift" and the introduction of a second "tumbler," as will be seen by reference to the diagram, where B and C are the tumblers, kept in their position by a spring D; the bolt being maintained in its place by two studs E and F, which are attached to the tumblers. The bolt being thus held in its place, it is only by the true key, whose slits correspond with the lifts of the two tumblers, that these can be so raised as to bring the studs into line with the slot

of the bolt, the top step of the key thus being brought to act on the talon H and unlock it. The effect of the upper transverse notches on the bolt is to make it impossible to discover by a false key when either tumbler is lifted high enough, and in this overlift we have the suggestion of much that was to follow in the way of "detector." A moderate degree of patience and ingenuity, was, however, still adequate to the picking of this Lock.

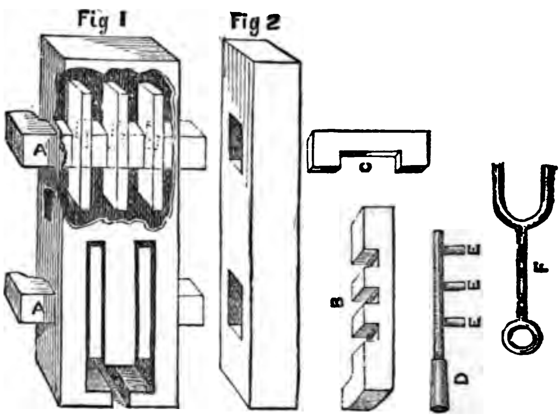
About the year 1778, a Lock with four double-acting levers was invented by Price, a piece of work which, at the time, promised so much practical use that it is surprising it did not gain general attention. The peculiarity of this Lock was that it locked without the key by pressing a stud or knob, which released a common tumbler in the main bolt; the four levers having plain gatings. The bolt was driven forward, or locked out, by a powerful spring, and "follow" pressing against the bolt-head. To unlock it the key was used in the ordinary way. All the modern *spring* or self-acting Locks, are constructed precisely on the same principle as that exhibited in this Lock, except that, in the *modern* Locks the driving spring is placed against the bolt-*tail* instead of the bolt-head.*

Mr Denison, who is himself the inventor of a valuable Lock, in his lecture† tells of a Chinese wooden Lock of very superior character to the Egyptian, and remarks, that it is exactly similar in principle to the long celebrated

* G. Price on Locks, pp. 267-8.

† Lecture on Locks. By Mr E. B. Denison, reported in *Doncaster Gazette*, 2nd January 1857.

Bramah Lock, inasmuch as it requires a number of independent sliders to be pushed into different depths before the Lock can be opened. "This very interesting and remarkable Lock," he adds, was shown to him by Mr Chubb, to whom it had been given by a gentleman who brought it from China. He did not know how many years, *or thousands of years* it had existed there, but probably, he adds, "long before Bramah's time, just as the recent invention here of that very neat and useful instrument the spiral or cork screw drill, was found to have been anticipated long ago in India." The most noticeable peculiarity of the Chinese Lock is that it is a "combination"—the first key touching three sliders at different depths—all requiring to be so raised before the bolt will move, and then a second



Chinese Lock.

double-toothed key being required to act on another set of levers, a very ingenious piece of work indeed.

The staple is made fast to the leaf of the door and over it is placed the main block, which is also secured to the door. The two eye-bolts are driven into the the other half of the door on each side of the head of the staple, and the bar of the padlock being passed through the eyes of the staple and the bolts, then becomes fast. The second block is placed over the padlock, and, a turn being taken with the three pronged key, the wards are raised and the top bolt is pushed into its place in the second block. The three-pronged key goes in upright and *turns* to lift the wards, being thus an advance upon the Egyptian. The two-pronged key enters transversely and is then turned half-round, but there lifts its wards after the Egyptian style. The key being removed the wards fall of themselves into the notches of the bolt and prevent its withdrawal until the key is again inserted and the wards raised. The same process is followed with the lower bolt, with the exception that the wards are raised by the fork-like key.

These Locks are sometimes used without the padlock and staple, the two blocks being fixed to the leaves of the door.

In Bramah's Lock, which was patented in 1784, there is a combination of direct and rotatory motion given to the key instead of simply the latter, as in Barron's. The great principle in it was the resting of a bar or bolt on six slides, with separate notches fixing the bolt in position; the end of each of these slides having to be touched by the key at a different level before the bolt could be liberated. Bramah's Lock for a long time defied every attempt to pick it. In one case a Lock was beside the operator for sixteen days, when he had undisturbed use of his tool-box and reflectors, and all that time the key was never applied. Such application would either have placed all the slides in their correct position, and thus have obliged the operator to begin *de novo* after each application, or would have

shown that the lock had been tampered with, and would, in this case, have acted as a detector. The padlock instead of swinging loosely, as in ordinary cases, was securely fixed, and instead of being fastened in an open pen, it was secured in wood, which afforded additional facilities for screwing and securing the apparatus.

While the proprietors of Bramah's Lock were more concerned with the commercial business of pushing this Lock than of still further improving it, the visit of the Prince Regent to Portsmouth in 1817 was destined to have a remarkable effect on the development of the Lock manufacture. A respectable ironmonger of Portsea had persuaded himself that the Bramah Lock was not perfect, and resolutely set himself to improve upon it. As he believed, he had already so far succeeded, and only wanted aid to introduce his invention to the public. For this purpose he had obtained an interview with an officer in command of one of his Majesty's ships in the port, and was engaged in showing his Locks to him when the Prince Regent chanced unexpectedly to come on board. In the hurry of clearing away as the Prince advanced, one of the Locks had been left on a seat on which his Royal Highness was about to sit down when he noticed it. He lifted it up and looked at it, asked why it was there, and on its being so far explained to him, he desired to see the maker, who was Mr Jeremiah Chubb. The royal approval gave him confidence and procured him the aid he needed, and his Lock was originally patented in the year 1818, and was immediately recognised as superior to anything that had preceded it.

In 1824 an improvement in the "detector" was patented by Mr Charles Chubb, in whose hands the manufacture had meanwhile been. Very soon he had a considerable factory and many men at work. But he did not by-and-by escape some of the penalties that fall to successful inventors. Trade jealousy took occasion and set ignorant misunderstanding to do its work. Malicious persons broke the windows of Mr Chubbs's house, which adjoined the factory. They tried also to injure his machinery, and in one case they made an attempt upon his person unsuccessfully. A reward was offered by the authorities for such information as would lead to the conviction of the chief offenders, who, however, escaped the hand of justice.

The distinguishing feature of the Chubb Lock was that it consisted of several separate and distinct double-acting tumblers placed over each other, capable of being raised to different heights, but all moving on a centre pin, and each requiring to be lifted to a certain fixed position before they would permit the bolt to pass. This Lock has undergone several material improvements since then, preserving, however, the six tumblers as essential to it. In the first place there is the detector, for which a patent was obtained in 1819, an improvement of the most signal importance. This is a spring-lever, which locks the bolt fast the moment that any one of the tumblers has been elevated an iota beyond its assigned range, and shows at once, on the application of the true key, that an attempt has been made upon it by a false instrument. The key proves an immediate rectifier by the simple process of re-locking, when

it will command the Lock in the ordinary manner by setting the tumblers in their proper position.

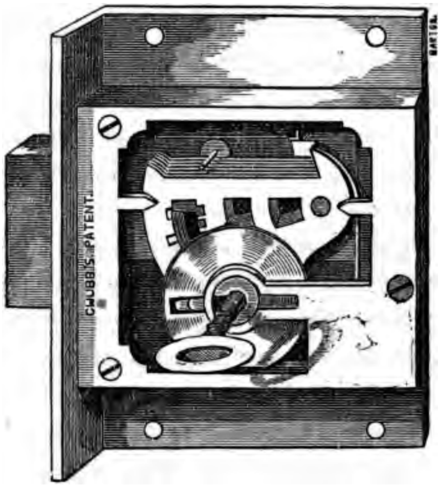
"It has been suggested that the "detector," instead of giving additional security to Chubb's Lock, affords a partial guidance to a [skilled] person attempting to pick it. This objection holds good *to a certain extent* in the Locks originally made, on which all the tumblers had an *equal* bearing against the detector-stump; but in the Locks as now constructed this objection is entirely obviated by giving the tumblers an *unequal* bearing, whereby, if an operator feels the obstruction of the detector-stump, he cannot tell whether the tumbler which he is lifting is raised too high or not high enough."*

The next improvement of importance was what is called the "curtain." Of course, there is no hindrance to the insertion of pick-locks into an open keyhole, even though they should prove useless; but by this ingenious contrivance, directly any false key or pick is turned in the Lock, the keyhole is closed and no other instrument can be inserted to aid the former ones.

Another element of great value in these Chubb Locks is that the essential parts which create the differences between the Locks are made by hand, and that a very great number of changes may be made in the combinations, each Lock being made to differ from every other. It is hardly credible, but it is a fact, that a three-inch Chubb Lock can have no fewer than 2,592,000 changes made in its combinations. A mere touch of the file will

* Tomlinson on Locks.

entirely change a Lock; and it appears that the difficulty is to make the Locks precisely alike, not to make them



The Chubb Lock.

different. Cheap machine-made Locks are of little value, simply because there are thousands of keys abroad which will open any of the same No. Apart from the bad work by which they are generally characterised, they are thus to be guarded against.

Doubts have been thrown on the possibility of such multiplied combinations; and though Mr Price would seek to reduce somewhat the claims of Mr Chubb in this particular, yet he himself furnishes a very apt and suggestive anecdote on the subject, which is so good that we must quote it:—

"A person wishing to dine every day with a small

family, happened to drop in when the family consisted of six persons besides himself. He asked mine host the amount he should pay to take up his abode in the house, as long as he could place the six different members of the family and himself in a different position at the dinner-table every day. Mine host thinking it would not be long, named a trifling sum. 'Oh, I am quite satisfied,' replied the stranger, 'for I shall now have to sojourn with you 5040 days.'"*

Series of Locks have been constructed by Messrs Chubb for prisons and bridewells, to the number of from 1500 to 2000, with master keys for the governor, deputy-governor, and chief warder. At any time the governor has the power of stopping out the under keys, and in case of any surreptitious attempt being made to open a Lock, and the detector being thrown, none of the under keys will regulate it, so that the governor must be made acquainted with the circumstance, he alone having the power with his key to restore the Lock to its proper state.

To Wolverhampton, which has all along been the chief seat of the Lock manufacture, Mr Chubb had transferred himself shortly after the public began to recognise the merits of his manufactures. The spirit of rivalry ran very high in Locks then, as indeed it has done since, and does now; but there can be no doubt that Chubb's Locks then took the first place and have held it. The public press soon began to set down its record. On May 9, 1832, we

* Price, p. 789.

find the *Wolverhampton Chronicle* writing thus impartially on the subject:—

"Independently of an endless variety, the inventions of numberless native individuals, we have had of late years those of Barron and Bramah, which acquired great reputation and maintained their superiority till of late, when they appear to have been in some degree superseded by those of Chubb, a respectable ironmonger of Portsea, who afterwards removed to London to promote their sale, and who has likewise established a considerable manufactory in this town to enable him to procure the best workmen, and offer his Locks to the public at the lowest terms. . . . We have no particular interest in any one individual, whether he be Barron, Bramah, Chubb, or any other, but we do feel a deep concern for the quality and reputation of one of the principal articles of our town's manufacture."

In a few years the name of Chubb was synonymous with his manufacture. He and his Locks were so widely known that a joke could be pointed by them without any fear of its missing the mark. *Punch* even found suggestion in Chubb's Locks for political cartoons. Thomas Hood wound up a punning poem in the *New Monthly Magazine* of June, 1842, with these verses:—

"Fair is the vernal quarter of the year,
And fair its early buddings and its blowings—
But just suppose, consumption's seeds appear
With other sowings!

"For me, I find, when eastern winds are high
A frigid not a genial inspiration;
Nor can like iron-chested Chubb, defy
An inflammation."

S

And a congenial fellow-magazinist thus signalised Chubb in *Tait's Magazine* for April, 1841 :—

"I met a cracksman coming down the Strand,
Who said : 'A huge Cathedral, piled of stone,
Stands in a churchyard near St. Martin's-le-Grand,
Where keeps St. Paul his sacerdotal throne !
A street runs by it on the northward. There
For cab and 'bus is writ "No Thoroughfare !"
The Mayor and Councilmen do so command ;
And in that street a shop with many a box,
Upon whose sign these fatal words I scanned :
"My name is Chubb, that makes the Patent Locks ;
Look on my work, ye burglars, and despair !"'
Here made he pause, like one who saw a blight
Crush all his hopes, and sighed, with drooping air,
'Our game is up, my covey, blow me tight !'"

These rhymes are of value, as they suffice to show that Mr Chubb did not follow the example of some of his predecessors in resting content with his first achievement, and subsiding into mere commercial activity, though in this he might almost have been justified. In 1833 and 1834 the newspapers contained many reports of cases of attempted burglary in which Chubb's Locks had resisted the most determined attempts, one of these being at the premises of a Mr Grant, merchant, in Chiswell-street. Then began a system of pirating Mr Chubb's name, though not his invention, a most inferior article being supplied, which on investigation was found to be the case in the robbery of the Glastonbury Bank, in March, 1833.

Meanwhile Mr Chubb had been active in his endeavours to produce a thief and fire-resisting Safe, and this he patented in 1835. A few years later, the bullion robberies

that had taken place on the railways led Mr John Chubb, who had by this time become active in the business, to concentrate his thoughts on a bullion chest which would defy such attempts. The extension of the business under his successors, who have introduced many valuable improvements, has become so great that for some fifteen years past the firm has maintained a manufactory in London as well as at Wolverhampton. In the large and well-ordered works in the Old Kent Road, the whole process of Safe-manufacture may be seen, as we recently saw it. Everybody may be presumed to be familiar with the appearance of the somewhat ungainly iron Safes, which are to be seen exposed, new or second-hand, at the doors of many warehouses. There are several makers of high reputation—Milner, Price, Tann, Chatwood, Hobbs. Messrs Chubb in this department of work enjoy some specialities. They have first the merit of plates case-hardened by a peculiar process; then the introduction of steel plugs and corrugated steel in such a manner as to frustrate any attempt at drilling through the iron, the edge of the drill breaking off short whenever it comes into contact with the steel; recessed doors, which present peculiar difficulties to the insertion of burglar's wedges; and "diagonal bolts," so fixing themselves into the frame of the safe as literally to become the more firmly fixed, as the more force is used to withdraw them; for, as these diagonal bolts fasten into a solid frame, which in its turn overlaps the body-plates, it is evident that if a burglar did succeed in getting a wedge past the rebate on the door, the moment the wedge was

driven in the bolts would only grip the sides of the Safe the more tightly. The Locks of these newest Safes (some of them most ingenious, and driving out a dozen bolts at once) are backed by a special preparation of steel, in addition to the steel plugs through the front iron, which makes it impossible for the drill to be used to cut off the portion of iron in which the Lock is fixed, as has been accomplished by burglars with the cheaper class of Safes.

The exposed section of the finest Chubb Safe may be described as consisting of four entire layers—wrought-iron, then hard steel specially prepared, wrought-iron again, and then, in fire-proof Safes, the fire proofing, composed of a yet more incombustible chemical material (chiefly silicate) than the old admixture of sawdust and alum. The edges are throughout joined by angle-iron, rivets and screws, and all are rebated and dovetailed together. The most recent style of Safe, constructed especially with a view to provide a strong Safe at a cheaper rate than hitherto, may be thus described:—The frame of the Safe on which the door hangs is a solid T-iron, its outer edge overlapping the body-plates, and the flange receiving behind it the bolts. Though the inner lining has no screw or rivet, yet it is most securely fastened in the process of joining the other parts. In order to increase the fire-resisting properties of this new Safe, besides the usual casing of fire-resisting material, a tube may be introduced into the open space behind the T-iron, filled with a substance that will, on the approach of fire, cause steam to be injected into the interior of the Safe.

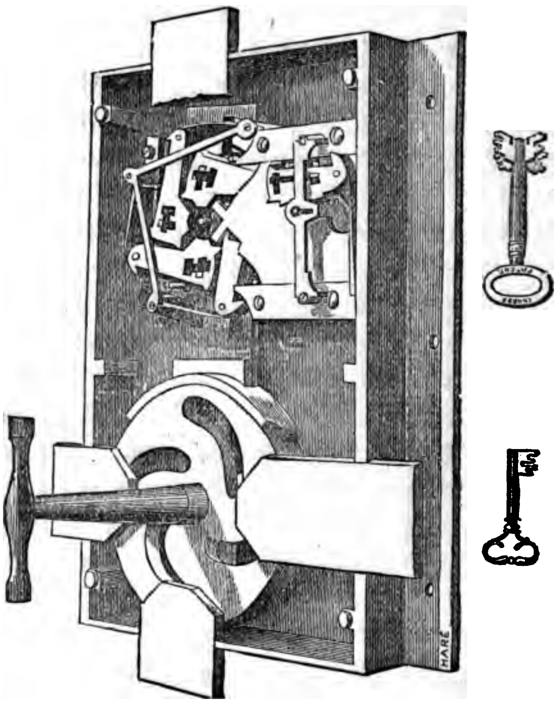
Mr George H. Chubb, in his book, "Protection from Fire and Thieves," gives the following passage with reference to the superiorities of the new fire-proofing material:—

"At one time tubes of glass, or fusible metal, containing alkaline solutions, were embedded in the sawdust, and were supposed to burst at given temperature; but it was found that the glass accidentally broke, or the fusible metal became corroded, and allowed the liquid to escape, thus damping the contents of the Safe. But the mixture of alum with sawdust is open to two objections; owing to the hygroscopic nature of sawdust the alum is liable to decomposition, thereby producing a certain moisture in the Safe; and secondly, there is, of course, a limit to the production of moisture from the alum when under the action of fire, after which the sawdust will become gradually dry, and although it may not actually ignite, it will become charred, and even red-hot, under sufficiently continued heat. It is but fair, however, to say that such instances of continued heat are but rarely probable; yet I prefer and use an *incombustible* material, which is very light and absorbent, and which does not possess the bad qualities of sawdust, but which is more expensive. Supposing the alum to become exhausted, there still remains the protection of a substance which is both infusible and a bad conductor of heat."

Looking at one of the finest of these Safes, so compact, solid, carefully finished, one is almost tempted to recall the epithet ungainly or "ugly" as applied to Safes. As one gets more and more acquainted with the process of manu-

facture, perfect adjustment of parts, and exact adaptation of every portion to its end, one actually begins to look at the iron Safe as if it had some *promise* of a thing of beauty.

The quadruple Lock, which Messrs. Chubb for many years attached to their finest Safes, was an admirable example of complex mechanism reduced to simple principles. It was really four Locks in one. The main bolts



Quadruple Lock.

were attached to an eccentric wheel, throwing them each

o these bolts ten or twenty Lock-heads might This Lock had six levers in each set, making twenty-four levers, all of which had to be acted ously, by the motion of the proper key, be- centric wheel could be turned. By a very ntrivance, which threw the wheel into the Safe-lock with diagonal bolts—which has now ch a marked feature of the Chubb Safes—was and this remains the most efficient, as it is simple, of the Messrs Chubb's many achieve-

nection with Safes, we should not forget to men- valuable inventions in powder-proof Locks that to Messrs Milner, Middleton and Price.

a word of warning must here be given. It is as essen- or safety to be careful of the keys as to have good Locks Safes. Nothing will avail if the keys of the Locks ecting valuable properties are not secure. No Lock atever will guard against culpable negligence with ard to its key; or, as in the famous South-Eastern ilway bullion robbery, the treachery of supposed trust- orthy servants. It will be remembered that the notorious ock-picker Agar said the robbery on this railway would e impossible unless copies of the keys could be taken. By ie connivance of a guard named Tester this was accom- ished, and yet the duplicate keys thus made were useless itil Agar had travelled seven or eight times to Folkestone the chests, altering the keys till they fitted. The robbery of several millions' worth of gold and

securities from the Manhattan Savings Bank in New York in 1879 was accomplished simply through the key of the Safe being committed to a keeper on the premises.

This the thieves had become aware of; and projected a plan of entry probably from the roof, so clever that it entirely baffled the detectives to say how they had entered; they manacled Werber, the man who had the key, and obtained possession of it; and, having done this, proceeded to the Safe, and began their work, which was thus in fact described by the *New York Herald*:—

"'It is the cleanest job that ever was done in New York,' said an old detective last night, referring to the Manhattan Savings Bank burglary. This seems to be the universal opinion of the police, and doubtless the 'cracksmen' who did 'the job," as they read these lines this morning in some cosy bar-room within a stone's throw of Police Headquarters, will appreciate the compliment to their skill, bestow a flattering wink upon each other, and order something hot. There seems to be a general impression among the detectives that some, if not all, the perpetrators of this remarkable crime are now in close proximity to the scene of their Sunday morning's work; and it may be safely asserted that there never was a case which the entire police force, from the superintendent to the most recently accepted patrolman, was more anxious to clear up than this. The audacity of the burglars in selecting a bank within a few yards of the Central Police Office, and one in which a very large proportion of the force have deposited moneys, and which was therefore

watched over with a sort of personal interest by the police, has excited in a remarkable degree the pride and combativeness of the officers, and impelled them to unusual efforts. There have been burglaries which realised larger amounts than this, but when all the circumstances are considered, it stands out as one that will long find a prominent place in the annals of crime. After the most careful search of the premises, not a single clue to the identity of the gang could be found. Not a trace was left behind save the costly and ingenious tools with which the work was done; and these, as might be supposed, furnish little, if any, clue. The success of the gang is pronounced almost miraculous by the detectives, and certainly nothing more audacious or wonderful can be found in the pages of Jack Sheppard literature. That six men, in broad daylight, should enter a bank in one of the busiest corners of Broadway, work for three mortal hours in plain view of any passer-by who chose to glance through the windows, hammering and banging at the ponderous doors of the Safe, bag nearly 3,000,000 dols. in cash and securities, and then disappear with their booty as completely as if they had vanished into vapour, is certainly as incredible a story as ever was spun in the brain of a romancist. The old adage that truth is stranger than fiction never found a better exemplification. Nothing else was talked of yesterday throughout the city, and the way in which the detectives have been roused to work the case is a revelation to the criminal classes."

And all this because the combination key was left in

the charge of an attendant on the premises. If no access to keys can be obtained, the most determined and the most skilful burglars have untold difficulties put in their way when they have to deal with good Safes and Locks even after they have found entry to the building. Mr Granville Sharp, in his "Prize Essay on Practical Banking," tells us, for instance, that when the Dorchester Bank was robbed some years prior to the publication of his essay, the burglars were in the house ninety-two nights before they succeeded in opening all the Locks, which they did by fitting false keys that would lock and unlock them. And Time has been very rich in improvements from then till now; so that, possibly, with a good "Safe" Lock now, the thieves would have required double the number of nights for their purpose, with, of course, all the additional risks of detection or failure.

There is one among the many practical suggestions given by Mr Price in his closing chapter of "Useful Hints," which we shall make bold to extract here because everybody can, at all events, wisely and profitably put it in practice on occasion:—

"Under no circumstances use violence when a Lock does not act properly. Violence will always do harm, whilst a little patience in 'humouring' it will, in nine cases out of ten, enable the key rightly to perform its office. The majority of Locks, if they are to go well, are like watches, they must have some degree of careful treatment. Instances are not uncommon of persons who have iron Safes, in the possible event of the Lock 'taking to go wrong,' putting

an instrument (as a piece of iron) through the bow of the key to act as a powerful lever, hoping by such violent means to make the key unlock it. In such cases the words 'open sesame' would be far more likely to produce the desired result. The result of such violence is that the *key-bit* breaks in the Lock, and then there is no alternative but to drill or cut open the door, and in many cases the Safe has to be sent to the maker to be opened and refitted, thus entailing on the owner a very considerable expense."*

The Chinese are called the most unprogressive and exclusive of peoples. But if the Chinese had some hints to give to us in the making of Locks when inventive progress in that industry began to re-stir in England, they have shown themselves by no means slow to take advantage of hints they have since been able to get from us in that line. This is one instance of industrious ingenuity:—

A gentleman sent a dispatch-box to a Chinese cabinet-maker to be repaired; it had a Chubb's patent Lock on it. After the box had been some time back his attention was accidentally drawn to the Lock; he examined it and found a facsimile of the old Lock had been put on, the man having retained the old Lock as a pattern.†

The duels that have been carried on by rival Lock-makers is one of the most curious things in the annals of industrial progress. "Our enemy is our helper," as Burke said; but it would almost have been beyond nature to expect that in all cases the Locksmith should have been

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* Price, pp. 893-4.

† H. R. in the *Times*, Nov. 1, 1861.

meekly ready to accept the dictum as final. Some men seem to have devoted themselves perseveringly to the business of attempting to pick famous Locks that they might entitle themselves to the reward offered by advertisement. Many professed to have picked the Chubb Lock; but failed in one form or other when subjected to the necessary tests. Even Mr Hobbs, who had trained himself more thoroughly than perhaps any man ever did before, failed under the agreed conditions fully to satisfy all those who were qualified to judge that the thing had been fairly accomplished. At all events, he soon had the tables turned upon him by Mr. John Goater, who, after having stated at a certain meeting that he had picked several of Mr Hobbs' Locks, and proceeded to show how it was done, was met by Mr Hobbs, who got up and said that he had become quite aware of it, and was just then improving his Lock—poor comfort for those who had meanwhile fitted up all their places with the discarded ones, warranted as "unpickable."

Mr Hobbs made a great sensation both by pen and tools when he came to this country some thirty years ago. There can be no doubt of his great ingenuity. He was a first-rate mechanic; but a disinterested person said of him that he was certainly not an economist; "his extravagant notions of costly and elaborate machinery would have come near to ruining the Bank of England." The Parantoptic or changeable Bank Lock is the highest reach of his genius; it is a remarkable production, exhibiting a mind of great fertility and resource. It may be thus described:—

The bits or steps on the web of the key, that net in the levers inside the Lock, are separate, instead of being, as in other keys, cut in the solid metal. These moveable bits are fastened by a small screw on the end of the shank of the key, when it has the appearance of any other lever-lock key. There are, besides, spare bits to change underneath. The Lock has three sets of levers, and is so constructed that, whatever the arrangement the bits on the key may have when acting on the Lock, the latter immediately adapts itself to the same arrangement, and will lock and unlock with perfect facility; but it cannot be unlocked by any formation of the "bits," except that which locked it. If a bit is changed in its place the Lock will remain locked, because, by the alteration, the key has also become changed in its action, to which change the levers will not answer.

As was almost to be expected from the peculiar intricacy of this Lock, and others of Mr Hobbs' make, the great practical objection to them is their aptness to get out of order, as was found at the District Bank in Liverpool, where, owing to this cause, they were disused in 1862. And the same change has since been made for the same reason in other banks.

There can, however, be no reason against saying that both Lockmakers and the public were much indebted to Mr Hobbs for the ingenuity which he showed in lock-picking during his visit to England about the time of the Great Exhibition of 1851. He awakened the manufacturers all round to the defects of Locks hitherto considered to be

secure; and was the means of calling forth new inventive capacity. In the official report of the discussion of the Institute of Civil Engineers on Mr Hobbs' paper "On the Principles and Construction of Locks," read on February 21, 1854, we find this passage:—

"The manufacture of Locks in this mechanical country had hitherto been conducted in the rudest manner, and with the most primitive tools; and whilst the price of common and insecure Locks was incredibly low, that of Locks of good construction was much too high to introduce them into general use. It was, therefore, the object of Mr Hobbs, by the employment of good machinery, to produce Locks of uniformly correct construction, sound principles, and at such a modified scale of prices as would ensure their general adoption, being assured that, whoever might be the maker, the most secure Locks, at the lowest price, would eventually take the lead with the public."

The charges and counter-charges of appropriation of principles it would be wearisome to follow, and by no means edifying. Simson's duplex bank Lock was charged with exactly reproducing Duce's sets of levers, and Chubb's quadruple was charged with reproducing Duce's quadruple of 1823. Mr Saxby, the working man who gained the prize offered by the Society of Arts in 1855 for the best and most secure Lock for ordinary use at a low price, was accused of reproducing an old idea, and had to testify that his literary studies had been less extended than he got credit for, and that his appropriation, if it was an

appropriation, was wholly involuntary. He was so poor that he had frankly to acknowledge some of the defects in his Lock, because he had been unable to purchase the proper tools that he desired in order properly to finish it; and yet great Lockmakers grudged him the little credit he got and his poor £10 prize-money, and showed as much ingenuity and spent as much ink as might have materially improved existing Locks and written exhaustive descriptions of them.

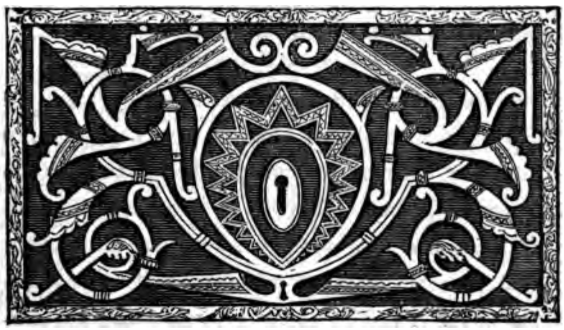
As a further specimen of the jealousy and the trade eagerness which were developed by the "Lock controversy," we must shortly refer to Mr Hobbs' great failure. Though some of his own Locks, guaranteed to the public as "unpickable," had, as we have seen, been picked by Mr. Goater, Mr Hobbs, by certain statements to the effect that the well-known Lock of Mr Cotterill, of Birmingham, was merely a modified Bramah Lock, and that he could pick it with ease, led Mr Cotterill to send forward a challenge. That challenge was accepted, Mr Hobbs undertaking to pick the Lock in twenty-four hours. In this he completely failed, after the most careful and resolute attempts; and he was compelled to acknowledge before the judges, that if "he worked at the Lock for a month, he should still be in the same position as he was at the close of twenty-four hours"—a very good but, as far as regards him, unfortunate testimony that *all* English work was not inferior to American.

The chief peculiarity of the Cotterill Lock was that it had twelve slides, which had to be operated on, so as to

force themselves, by means of a sloping or bevelled edge, into a groove in an outer ring, which was placed round the central Lock; and till all the slides simultaneously did this, the Lock could not be opened. Every slide on being picked, by any instrument, from the centre to the periphery, impinged on the external steel ring; and only by increasing pressure to the due degree being applied to all the twelve slides at once could the bolt be moved.

It will not be out of place if we should say a word or two about Mr Parnell's famous Lock, which appears to be so constructed that pressure obtained against the bolt, without the proper key, entirely *stops the action of the levers*, an end accomplished by giving the Lock or bolt two actions—namely, a forward and a backward one, in the simple act of locking and unlocking. This is done by a single revolution of the key as in locking any ordinary Lock. The levers are adjusted twice by a simple mechanism ere the Lock can be unlocked; and this must be done, in the first place, before any pressure is applied. The stump of the bolt is original and peculiar. It is propelled into a special or third chamber, formed in the levers. The stump enters this chamber in locking: and it is effected by the back action already mentioned. To make this important feature clear, we must add, that after the bolt of the Lock is shot out, and held there by the levers, *the bolt*, in the further revolution of the key, *recedes*, and *locks down* the levers, thus entirely frustrating the *modus operandi* of the scientific and experienced lock-picker, as also does the safeguard of a shield, supported upon a high circular ward, upon which it re-

volves, also revolving in the cap-plate of the Lock, which entirely closes the key-hole during the operation of locking or unlocking. This shield, being connected by a stump or notch with the lever, must be turned, thus shutting out the lock-picker even from attempting to raise the locked levers.



Old Church-door Lock, polished steel on teak.

The curiosities of Locks would in itself be a fruitful subject. We have in our possession a very fine padlock sent to us by a lady from India. On the key being turned to unlock it, several distinct notes somewhat like the sound of a small bell, are given out, sufficiently loud to act as a detector if any one were in the same house. The padlock is of brass, and we were told that it was made in Jessore, Rajpootana. A very different Lock from this, but equally curious is the old-fashioned "Amen" Lock, which means a padlock formed of rings marked with letters which when placed to form a certain word will open, but not otherwise. This is an older invention than

might be supposed, for we find it thus spoken of by Beaumont and Fletcher :—

> "A cap-case for your linen and your plate,
> With a strange Lock that opens with A. M. E. N."

It is noticed also in some verses of Carew, addressed to May, who died in 1650, on his Comedy of *The Heir*.

> "As doth a Lock that goes
> With letters; for till every one be known
> The Lock's as fast as if you had found none."

The Dial Lock was another curiosity of invention. You had to fix on a certain word and set your Lock to it; then on returning desirous to open the Lock, you had to turn a pointer on the face of the dial in succession and in order to the letters of the word by which your Lock had been set, and by arrangement of which the bolt was withdrawn at the close. In spite of the great advantages which Mr Brown, the inventor of one of these dial Locks, set forth as follows, the dial Lock has not come into general use :—

"First," he said, "it cannot be picked, for there is no hole. Second, it cannot be blown up by gunpowder, for the same reason. Third, you cannot drill through the door so as to reach the Lock, for you are intercepted by a steel plate on which your tools will not act; thus you cannot introduce gunpowder that way to force the Lock off. Fourth, you cannot bounce off the wheels in the interior with a muffled hammer, for vulcanised india-rubber springs resist this. Fifth, you cannot drill the spindles out, as their heads are case-hardened. Sixth, you cannot drive them in for there are counterparts in the door

about half-way through."* Instances innumerable of this might be furnished from the history of the Wolverhampton Lock trade itself. One example may be given. Dr Plot, in his "History of Staffordshire," writes of the Locksmiths there in the seventeenth century:—

"So curious are they in Lock work that they can contrive a *Lock*, so that the *master* or *mistress* of a family sending a servant into their *closets*, either with the master key, or (if they permit an *inferior key*) with their own, can certainly tell by the Lock how many times that servant has been in, at any distance of time; or how many times the *Lock* has been shot for a whole year together, some of them being made to show it 300, 500, or 1000 times; nay, one of the chief *workmen* of the *town* told me (might he have *workman's* wages) he could make one that would do it 10,000 times. Further yet, I was told of a very fine *Lock* made in Wolverhampton, sold for £20 that had a set of *chimes* in it that would go at any hour the *owner* should think fit. And these Locks they make either with *brass* or *iron* boxes so curiously polish't, and the keys so finely wrought, that 'tis not reasonable to think that they were ever exceeded, unless by *Tubal Cain*, the inspired artificer in brass and iron."

It is remarkable that, while even thus early in England so much ingenuity should have been shown in producing toy-Locks of this kind as mere curiosities, the Locks generally in use should have for so long a time, remained

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* Price, pp. 215-6.

so rude and so far beneath the requirements of security. Equally strange is it that, though Locks followed each

Designs for Keys from Old Patterns.

other generation after generation in the same poverty of invention, they should often have been so richly ornamented externally as to have furnished a fine field for the designers of modern ornament in Locks—not a few of the finest designs of polished and jewelled Locks and keys sent to the Paris Exhibition of 1879, particularly by Messrs Chubb and Son, having been suggested by these ancient designs. Some of the cut polished steel keys were truly beautiful, not surpassed in tastefulness even by those in gemmed gold work, fit for the jewel-case of a king.

This our readers will get a faint idea of from the little cuts which are inserted above.

But we must take leave of the subject. Some of our readers, as we hope, will look with more of interest on the very common and useful instruments of all sizes which are now so essential an adjunct of civilised life, from having read this brief description of Lock-history and Lock-manufacture; and if it be true, as has been said, that "most robberies are due to trusting to bad keys," they may be able in some way to turn the information to practical benefit. Such, at all events, is our desire.

Mediæval Lock and Safe-makers' Forge.

THE POST OFFICE.

The story of the Post Office succinctly illustrates the manner in which the public have had, in great social reforms, to help themselves; and how little aid they have derived from those in high places, who, in this case, at all events, have sometimes played very much the same part, as Dr Johnson affirmed that the Earl of Chesterfield had played towards him — namely, to stand apart while the strugglers were in the water, and then, when they had reached the shore, to encumber them with help. In old days the Post Office was a Government monopoly, as it still is with respect to its most important departments, but with this difference, that the poorer classes then paid, and paid dearly, for the great mass of the privileged in the transport of letters and parcels. The benefits that we now enjoy were not conceded to us by kings and princes and statesmen, but were slowly wrung from that class by the efforts of the people themselves, well embodied in the persons of three notable worthies — an upholsterer, an actor, and a schoolmaster.

The Postal Service in this country began with special messengers, sent by public and private personages, and with common carriers, who travelled with pack-horses, in the stormy time of the wars of the Roses. These carriers went through their journeys without changing horses, and, of course, their pace was very slow. As the roads were bad, the blame was chiefly laid upon them. Their charges, however, were not high, for the Bristol Corporation only paid a penny for the carriage of a letter to London, though it must not be forgotten that a penny then represented a far higher value than at the present time. Government posts—that is, relays of horses and men—were not established until nearly two centuries later, though "post-horses" had long been kept by inn-keepers and private individuals for hire. James the First set on foot a Post Office for the benefit of English merchants trading abroad. It was not, however, until the reign of Charles the First that a Post Office for inland letters was established. This Postal arrangement covered a few main-roads and by-roads —chiefly the lines from London to Edinburgh, London to Chester and Holyhead, and London to Exeter and Plymouth, Oxford and Bristol, and Colchester and Norwich. The rates of postage were high, the object of the Crown in establishing this Letter Post being quite as much the idea of revenue and the formation of a profitable monopoly as the accommodation of the public. Like all short-sighted traders, it wished big profits on a small turnover, and not the reverse, as it should be. Twopence was charged for the carriage of a single letter for any distance

under eighty miles, fourpence up to a hundred and forty miles, sixpence for any longer distance in England, and eightpence to any place in Scotland. The Post between London and Edinburgh was commanded to run from the one to the other and come back in six days. We read that on one occasion the London Office sent only a single letter. The prohibition from carrying of letters by any persons other than those employed by the King's Postmaster caused great dissatisfaction, and the subject was brought before a committee of the House of Commons. The usefulness of the institution, however, was too great to admit of its abandonment. Nothing was done further than to put down a rival Post Office started by the Corporation of the City of London in 1649, when the amount of the revenue derived from the Posts was £5000. From that time the trade of letter-carrying has been in the hands of Government.

Robert Murray, upholsterer, in the year 1680, established a Penny Post for the conveyance of letters and small parcels about London and the suburbs. His interest in this undertaking he by-and-by assigned to William Dockwra. This may be called the first great postal reform, and a contemporary writer thus speaks of it:—

"The Penny Post Office is a late office at London only, whereby for one penny any letter or parcel, not exceeding one pound weight or ten pounds value, is most speedily and safely conveyed, to the great benefit of the City of London, and all the parts adjacent only within twelve miles round."

This was a London foot-post, like the present, with seven sorting-houses, between four and five hundred receiving-houses, and with four deliveries a day. Dockwra, in the face of much opposition, conducted his undertaking with such success for some years, that it excited the jealousy of Government. It was at last seized on the ground that it was an infringement of the rights of the Crown, and it was not till some years after that a pension of two hundred a-year was granted him as compensation. This was the commencement of the London District Post, of which Dockwra was subsequensly appointed comptroller. Up to a late year, this existed as a separate department of the General Post Office. He was the first to stamp letters with the hour at which they left his office for delivery, and the first to put a bar on the conveyance of combustibles and perishables. We learn, indeed, that he was accused of forbidding the sending of band-boxes and of delaying physic sent by doctors, and so hazarding the lives of patients. In 1698 he was removed from his office on a charge of mismanagement,. In 1708, an attempt was made by Mr Povey to establish a halfpenny post in opposition to the official penny post; but this enterprise, like Dockwra's, was speedily suppressed by Government.

In 1710, during the reign of Queen Anne, the Post Offices of England, Ireland, and Scotland were brought, by Act of Parliament, under one management; and in 1720 a great improvement was effected by Ralph Allen, who re-organised the "cross-posts" under a contract. Many neglected districts were thus brought within the postal service, and he

realised more than half a million sterling by his ingenuity. He spent his money mainly in works of charity, and sat to Fielding for the portrait of Squire Allworthy in "Tom Jones." He is also referred to in the correspondence of Pope, and would seem to have in several ways cultivated literary society. On his death in 1764 the "cross-posts" were put under a manager with a salary of £300 a year, and the annual profits from this source, at this time, were about £20,000, notwithstanding the loss to the revenue arising from illegal letter-carrying. We learn that the post-boys were hard to cure of their propensity for increasing their gains by bits of business on their own account; and that a good deal of whipping and imprisoning was done by way of warning to the tribe. The service was much interfered with by too generous gentry, "who did give much money to the riders, whereby they were very subject to get in liquor, which stopes the males," and by old broken-down or apprentice highwaymen who were not fit for more dangerous work. Robbing the mail in those days was looked upon as "light business" for an expert hand, very much as the kinchin-lay was to Dickens' Noah Claypole, *alias* Morris Bolter. Not only on country main-roads and in country bye-lanes was this crime committed, but, with comparative impunity, in the thoroughfares of London itself. At more than one of the narrow outlets from London it was customary to draw a string across from wall to wall, and over this the ambling post-boy would stumble, his bags being seized in the fall, while he had to return to the head office to report the robbery.

The annual expense attending these robberies—to say nothing of the loss of property—was great. In 1783 it was £4000.

Though it was well known that post-boys were often robbed when in liquor, and were not seldom suspected of themselves aiding in or conniving at the robbery of the "males" with which they were entrusted, there were people who had a vested interest in maintaining the system, and fought against its abolition. These were chiefly the officers of the Post Office and their friends. The fact is an encouragement to all reformers,. The old divine says: "No good thing was ever easily come by," and certainly this reform was not accomplished without great effort and labour. It was properly the first introduction of scientific system into the postal service; the Columbus-like standing of the egg on its end. Mr Pitt was quick to see the merits of the plan; spoke powerfully in its favour in Parliament, and it was, after a considerable struggle, carried through.

To John Palmer, an actor and manager of the Bath Theatre, must be given the credit of the next great reform, that speedily gave security as well as increased speed to the national correspondence. This was in 1784, and his plan may be shortly described as a system of trunk lines and feeders. Columbus and his egg often recurs to the mind in following up the histories of our most cherished institutions. Seeing that a system of mail coaches was already in existence, running regularly over well-defined roads, it is amazing that no one for so long a period dreamt

of connecting the Post with it. To Palmer is certainly due the honour of this improvement. On all the road lines the slow and often niggard and drunken post-boys were soon abolished. Palmer was appointed Comptroller-General of the Post Office, at a salary of fifteen hundred pounds a year, and a commission on all receipts above a certain amount. The speed of the mails was at once increased to six miles an hour, and before long to nine or ten miles. The correspondence and revenue increased, and they continued to advance steadily for many years.

So late as 1790, when Mr Palmer proposed further improvements on his system with regard to the rate of travelling, a Mr Hodgson, one of the Post Office authorities, opposed the alteration as worthless, because founded on an impossibility. The "impossibility consisted in supposing that letters could be carried from Bath to London in 16 or 18 hours."

Mr Palmer was discharged abruptly in 1792, owing chiefly, we learn, to the decided position he had taken up against what is known as the system of "franking," by which the officials of the Government and their friends could burden and practically monopolise the mails. Palmer clearly was an "honest man" and a patriot. He had the public good only in view, and suffered by it, as such men are wont to do. Instead of praise they receive kicks—sometimes for bread a stone—and even the stone has, we may almost say, been refused to Palmer; for the name of the man, who in some respects prepared the way for Rowland Hill, and without whose labours Rowland

Hill's reform had not been so easy, if indeed it would have been at all possible, is forgotten. But Palmer did not quit his hold without a fight, and doubtless did some good by his fighting, as may well be conceived when we say that the contraband trade was still enormous; that all kinds of tricks were resorted to to evade the law; that parcels of letters were sent by coach; and that in some places not more than one letter in fifty was paid for to the Post Office. Palmer's opponents—the men who abused the privilege of "franking," not only granted covers to their friends, but sold them through their agents. Right of passage was thus given to everything, from a note to heavy "bandboxes" and "mattrasses." This franking system began with the Post Office Charter in 1660, and was only got rid of completely in 1840 on the establishment of penny postage.

Palmer was defeated in his endeavours to reform the postal system further; but he worried the Government and the officials till they had, finally, in sheer weariness of his importunity and agitating, to silence him with a grant of fifty thousand pounds. This was after a period of twenty-one years from the time of his discharge, during all which time he had been drawing some three thousand a year—a sum somewhat under the salary he had enjoyed; and the country all the time was denying itself the benefit of his services, which were so valuable, and which he was most willing to give—a specimen of economy such as later days has only too often seen repeated.

The year of Mr Palmer's discharge—1792—was dis-

tinguished by the opening of the first Money Order Office. This office was originally managed by a few of the Post Office clerks for their own profit, but in the memorable 1838 it became a recognised branch of the establishment.

About the year 1818, Mr Macadam's improved road-making had begun to be of great service to the Post Office, by giving greater speed to the mails; and the opening of the line between Livcrpoool and Manchester in 1830 inaugurated the great system of railway letter-carrying. Since then the railways and the Post Office may be said to have grown up together. Following close upon this important change—in the early part of 1837, came the greatest reform of the postal service. In that year Mr Rowland Hill, who had often talked over the matter with Charles Knight, and most probably derived the idea as well as stimulus from that remarkable man, broached his great plan of inland penny postage, met with some support, but with more opposition and ridicule. He published a pamphlet, showing nearly every step in his laborious calculation, which proved that a uniform penny rate was at once both just and practicable.

Not only did Mr Hill propose that the rate of postage should be *uniform*, but that it should be charged *according to weight*, and that payment should be made *in advance*. The means of doing so by stamps was not suggested in the first edition of his pamphlet; and Mr Hill said that the idea did not originate with him. It was, as we have hinted, due to Charles Knight. In a later issue, he says:

"Perhaps the difficulties might be obviated by using a bit of paper just large enough to bear the stamp, and covered at the back with a glutinous wash, which, by applying a little moisture, might be attached to the back of the letter."

From inquiries, Mr Hill established the fact that the actual cost of carrying letters from London to Edinburgh, when divided among the letters carried, did not exceed one penny for thirty-six letters. That is taking the average weight of a letter at a quarter of an ounce, the cost of its transmission was not more than *the ninth part of a farthing.* And the Post Office got 1s. 6d. and yet could not make it pay.

No wonder that the scheme startled the public and that the official mind was much exercised. Everyone knows how under the old system, poor people often declined to receive letters, being unable to pay the postage; that signs and hieroglyphs worked into the address, were at a glance made to convey news; and that, these being seen, the letter or newspaper was returned to the postman; while, again, it was so thoroughly against good taste to prepay a letter; that it was easy for a certain class to victimise those they disliked.

By his energy and determination, Mr Hill forced the House of Commons to consider his scheme. After a full investigation by a Royal Commission, and a select committee, the great penny postage plan was reluctantly adopted by the Legislature, and in September, 1839, Mr Hill was appointed superintendent to carry his plan into effect.

How often very small matters determine great issues! The length of Cleopatra's nose, it was said, caused a grievous war. The use, by-and-by, of the simple substance gum was the beginning of the great increase of postal work. When the business of writing a letter was simplified by an easy substitute for wax and wafer, and the facile process of affixing a stamp came in place of the payment of money at the Post Office, the number of letters soon immensely increased.

The accession of Rowland Hill marked the death of what we may call the wax and wafer age, and the birth of the gum and envelope age. Mails increased in speed and number, and mechanical improvements quickly followed one another—adhesive labels with perforated dividing-lines; envelopes, first ungummed and then gummed; the travelling Post Office on the railways, which consists simply of a carriage fitted up for clerks, where the operations of sorting and stamping are performed while the train is in motion—a wonderful advance and saving of time, so easy that it is surprising it was not thought of before—the exchanging apparatus, by which mail-bags are discharged from or gathered into the travelling Post Office while going at full speed; and, finally, the pneumatic tubes by which packages of letters and newspapers are blown from one point to another—an invention which has been found a very useful adjunct to the telegraph system in London.

The results of these postal reforms exceeded the most [illegible] expectations. When Rowland Hill published his

pamphlet, the lowest general post rate was fourpence; and the old rate required to carry a letter from London to Reading or Chatham, is now more than sufficient for its conveyance to any part of Canada, India, or Australia. During the twenty years from 1815 to 1835 (inclusive), there was no increase whatever in the Post Office revenue, whether gross or net. What a contrast this forms with the rate of increase under the new system. In the first year of Penny Postage the letters more than doubled; every year has shown a vast advance on the preceding year.

Rowland Hill's inventive and administrative genius soon found unlimited exercise when it had as a basis the Penny Postage system. He simplified the whole machinery of the department; the establishment and regulation of the Book Post was an immense step; and soon it underwent many improvements at his hands; the reduction of registration fees greatly lessened temptation to sorters and carriers, always inevitably subject to it; and the great reductions that followed each other in the charge for Money Orders were amply justified by the great extension of the system, attesting the soundness of the principle on which he had from the first proceeded in everything relating to the postal system. While the revenue of the Post Office has year by year increased, the indirect benefit to the general revenue of the country, arising from the greatly increased facilities afforded to commercial transactions, must be incalculably large. This indirect benefit is well manifested in the development of the Money Order system, under which, since the year 1839—the first year

of its official existence—it has risen from a little over three hundred thousand pounds to nearly thirty millions in the year 1878-9. The Foreign Money Order Office has been of vast service. We should not forget to mention here that the unclaimed Money Orders are always carried to a fund to assist the officers of the department in insuring their lives.

Well does Sir Rowland Hill deserve a statue; for low and high alike are daily debtors to him—the Canadian backwoodsman in his log hut; the gold miner on the distant claim; the Australian shepherd in his ranch; the sailor on the sea making for a foreign port; the soldier at the ends of the earth fighting the battles of his country, are still held by invisible bonds in close and more intimate relations to home and friends by his active and ingenious efforts.

The development of the telegraph department has been a great feeder and support of the postal system—not by any necessity a department of the Post Office, yet it is, we may say, naturally so, and certainly the association has worked beneficially to both. The name of Mr Scudamore as the organiser of this department should not be forgotten. He was a genius in administration and in the power of infecting others with his own energy. As a general rule, what the Post Office for perfection of method and usefulness still needs to aim at is precisely that which Sir Rowland Hill in his long life aimed to attain—greater simplicity of system, so as to save the public all possible exercise of thinking and consequent loss of time.

The organisation so greatly improved and extended, as we have seen, for postal purposes stands available for other objects, and, passing over minor matters, has already been applied with great and remarkable advantage to the system of Savings Banks.

The total number of officers in the service of the Post Office at this moment is about 46,000, and of that number about 11,500 are employed exclusively on telegraph work. There are 13,881 postmasters, 9836 clerks, and 22,068 letter-carriers, sorters, and messengers.

The total postal revenue for 1878-9 was £6,274,000, showing an increase on the former year of £227,000. The chief items of expense were £2,178,000 for salaries, wages, and pensions; £685,000 for conveyance by mail packets, and private ships, £697,000 for conveyance by railway, £178,000 for conveyance by coaches, carts and omnibuses, and £157,000 for buildings, repairs, &c. The earnings of the telegraph service were £1,346,892, showing an increase on the previous year of £13,350, and the expenditure £1,089,000. Since the establishment of the Post Office Savings Banks, 5,783,527 accounts have been opened, and 3,890,771 have been closed, leaving 1,892,756 accounts open on 31st December, 1878. The total amount deposited from the commencement, exclusive of interest credited to depositors, was £111,012,000, and the amount withdrawn, £80,601,000, leaving a balance of £30,411,000.

The average weight of mails received daily at the Chief Office, London, is 23 tons, and of mails despatched, 43 tons. On heavy mail days, these weights may be taken as 26 and

53 tcns respectively. The great disparity between the weight of mails outwards and inwards is partly due to the fact that London issues far more correspondence than it receives; and partly to the circumstance that a larger proportion of correspondence is sent from the travelling Post Offices direct to the District Offices, without passing through the Chief Office, than is received by the travelling Post Offices from the District Offices.

In 1846, on the establishment of Penny Postage, there were only 4028 places of deposit; now in London alone there are nearly half that number—1981.

The number of letters delivered in the United Kingdom during the year 1878-9 was greater than the number delivered during the preceding year by 39,640,500, thus showing an increase of 3·7 per cent; post-cards had increased by 9,208,400, or 9 per cent; book-packets and circulars by 7,775,900, or 4·1 per cent; and newspapers by 2,337,300, or 1·8 per cent.

The letters delivered in the London district form rather more than one fourth of all the letters delivered in the United Kingdom. They are more than twice as numerous as the letters delivered in Scotland, and above three times as numerous as the letters delivered in Ireland. In the East Central (or city) District, in which twelve deliveries are made, out of 1,754,000, delivered weekly, about 1,008,000 or 57 per cent fall into the first delivery, and about 280,000 or 16 per cent into the last delivery. Out of 2,415,000 letters posted weekly, 218,000 or nearly 10 per cent are for delivery in that district. About one

million letters a week are posted at the General Post Office itself; more than half-a-million at Lombard Street; about a quarter of a million at the branch office in Gracechurch Street; nearly as many at the branch office in Mark Lane, and about 200,000 a week at the branch office at Ludgate Circus. The average daily number of registered letters delivered in the East Central District approaches 5000: *on Mondays the number rises to* 6000.

In curious letters and in curiously addressed letters the reports are very rich, and might, when put together, form a valuable chapter of light or half-comic reading. Nothing could more testify to the urgent need for the School Boards than the wide-spread ignorance which exists respecting the functions of the Post Office. A few letters, addressed to the Department, from recent reports, will prove it:—

I.

"John —— acting as Farmer here would be very much obliged to the Postmaster at —— if he would be so good as to name a suitable party at —— to whom he might sell a 30 stone pig of good quality well—for he understands it is the best place to sell. The pig is now quite ready for killing."

"Dear Sir,

"Enclosed you will please find a letter which I would like for you to give some young lady or gent—lady preferred—who you think would like a correspondent in this country. Will correspond on topics of general interest. For further particulars glance at enclosed letter, as it is not sealed.

II.

"Dear Sir, "TENNESSEE.

"I want you to do me a kines to hand this to some good watch maker and tell him to see if I can by a instrument to tell where gold or silver is in the ground or if there is a instrument maid to find mettel—gold or silver—that are in the ground. If it will attrack it—a instrument for that perpos—I understand there are sutch a thing made. If so, be pleas tell me where I can by one and what it will cost me—It can be sent to New York to —— where I can get it—I want to get a instrument to hunt gold and silver—You will pleas write to me as I think if there are sutch a thing maid I could get one in your country—I send you a stamp.

"———, Indiana, U.S."

III.

"Dear Sir, "WALES.

"I am taking the liberty of writing you those few lines as I am given to understand that you do want men in New South Wales, and I am a Smith by Trade, a single man. My age is 24 next birthday. I shood be verry thankfull if you wood be so kind and send all the particulars by return.

IV.

"Sir, "——— SCHOOL.

"Not having received the live bullfinch mentioned by you as having arrived at the Returned Letter Office two days ago, having been posted as a letter contrary to the regulations of the Postal System, I now write to ask you

to have the bird fed and forwarded at once to ——, and to apply for all fines and expenses to ——. If this is not done, and I do not receive the bird before the end of the week, I shall write to the Postmaster General, who is a very intimate friend of my father's, and ask him to see that measures are taken against you for neglect. This is not an idle threat, so you will oblige by following the above instructions."

V.

"Sir,

"Will you do me the favour of dropping me a line to say if you know of an Herbalist or Greengrocer that could send me a parcel of Mithridate Mustard—It grows at Hatfield by the river side and in the street of Peckham on the Surrey side. As I am a stranger, if you will kindly see if you can get any one to send it me I will send a post office order or stamps for what it will cost before they start it by train; or if you will get it I will send it to you. I will send you some partridges for your trouble if you will kindly let me know. It dont grow in any part of ———shire that I am aware of—We have the common hedge mustard growing here but that wont do what the gentleman wants it for."

VI.

"My Lords and Gentlemen,

"I humbly beg your consideration if there is no law to stop persons from calling all manner of bad names day after day as it is annoying me very much in my calling as a Gardener & Seedsman; as I have applyed to the office at

—— for a summons for a little protection and they tell not, so i think it rather too hard for me as i have done all the good I have had the means to do with to the Hospitals and Institutions and all charityable purposes both in —— and elsewhere if needed, but I suffer from lameness with a ulcerated leg not being able for laborious hard work although i wish to do as i would be done by. Please to answer this at your leisure."

VII.

"To the Edetior of the General Post Office, London.

"Will you please oblige Susannah —— and Walter —— with the particulars of an aspecial licence to get married is it possible for you to forward one to us without either of us coming to you if you inclose the charge and have it returned would we get one before next Monday week to get married at ——. If you will kindly send by return to the address inclosed the particulars we should feel greatly obliged."

VIII.

"Sir, "KENT.

"Will you please inform me if there is to be a Baby show this year at Woolwich; if so, where it is to be holden, and what day.

"I have enclosed —— stamp."

What seems to be a common error among the very poor, is that the Dead-letter Office has some connection with the recovery of missing persons, or is a universal registry of the unknown dead. Here are a few letters which bear this out:—

I.

"Dear Sir, *May*, 1877.

"I write to ask you for some information about finding out persons who are missing—I want to find out my mother and sisters who are in Melbourne in Australia i believe—if you would find them out for me please let me know by return of post and also your charge at the lowest.

"Yours, &c."

II.

"Sir, "LONDON.

"i right to you and request of you sinsearly for to help me to find out my husband. i ham quite a stranger in London, only two months left Ireland—i can find know trace of my husband—Your the only gentleman that I know that can help me to find him, thears is letters goes to him to —— in his name and thears is letters comes to him to the —— Post Office for him—Sir you may be sure that i ham low in spirit in a strange contry without a friend. I hope you will be so kind as not to forget me. Sir, I would never find —— for I would go astray, besides i have no money."

III.

"Sir,

"I have just been hearing of 3 men that was drowned about 9 months ago. i hear there was one of the men went under the name of John ——. Could the manager of the Dead Office give any particulars about that man, what he was like, or if there was such a name, or if he had any friend. He just went amissing about that time. I here enclose a stamp, and address to, &c., ——.

IV.

"To General Post Office, London.

"I right these fue lines to you to ask you if you would be so kind as to teel me if there is such a person living in england. She was living at Birmingham last Rtimmas — this his mi sister and brother-in-law — they hant in Birmingham now — let this letter go to every general post office there is."

Also, that it is a kind of extensive missing-heirs discovery office, as this will show:—

I.

"Sir,

"As I have no correspondent in London present I adopt this plan of securing one that I can transact business through—the matter I wish to call your attention to is this. To the estate of —— and the —— heirs.—The papers were sent here once but have been lost.

"—— died in London about 45 years ago and left a large estate of which my client's interest would be about seventy-five thousand dollars at the time of his death. Will you please inform me what it is necessary for us to do in the matter in full.

"I am, &c."

II.

"Honored Sir, "KANSAS.

"My Grandfather Mr John —— made a will on or about 22 Oct. 18— dated at —— leaving to his son, my Father, £1000, the interest to be paid to him half yearly, the prinsaple to be divided among his children at his death. My father died on the —— last leaving myself

and one brother who wishes you look up & collect the money for us."

III.

"Sir,

"i rite a Line two see if you hard ennything of my husband —— that was left at —— ill. pleese will you rite back by return of post as we are in great trobble.

"To Controul of the Dead Office, Newcastle."

From the moment that a letter leaves the hands of the sender, and falls into the box, it becomes the property of the Post Office for purposes of delivery, and cannot be withdrawn. If it contains any hasty phrase, and any bitterness of tone that the writer regrets; if its weight is greater than the head or heads on its surface will carry, or if any important particular is thought to be omitted in its address, it must, nevertheless, go unaltered through all the allotted stages of its course.

This being the case, we may with the more interest follow some typical letters in their career through the Post Office—a career sometimes as varied as to impart a touch of romance—and, as they lie ready to our hand, we shall take the liberty of extracting a few paragraphs from the pen of one who knows well that of which he writes:—

"It is a striking and gratifying fact that only a mere fraction of the total number of letters posted fail to reach their destination. People often grumble at the bore of letter-writing, but seldom think of the boon they enjoy in the penny post. To write, address, and post a letter—and this is all the sender is required to do—is a mere trifle,

compared with the labour of the Post Office in earning the "nimble penny," which is affixed to the letter in the shape of the "Queen's Head." Think of what has to be done for a letter posted, say, in the suburbs of London, and addressed to some remote village in the North of England or in Scotland. Perhaps it has been posted over-night, in which case the letter-carrier will be busy collecting and conveying it to the sub-district Office some hours before moderately early people are thinking of getting up. From the Sub it will be conveyed to the Head District Office, there to be stamped, sorted, and despatched to St. Martin's-le-Grand. Here, in company with many thousands of others which have arrived in the same way, it will probably be manipulated as many as half-a-dozen times, in the different processes of facing, dividing, sorting, and so on, before it reaches the stage of being tied up in a bundle with a hundred or more of its fellows addressed to the same town or district, and despatched on what may probably be only the initial stage of its journey. If a night letter, Fate may decree that it should pass under the scrutinising glance of that sleepless official, the travelling sorter; in which case the bag, with its seal hardly "set" as yet, will be ruthlessly torn open, and the bundles dispersed to the four corners of the railway sorting tender. Here is a miniature Post Office, with pigeon-holes, bags, and bundles innumerable; whose officials, in a desperate effort to keep ahead of the train, wait not for the shrill whistle of the guard or the first puff of the engine to commence their hard night's work. There are letters, letters

everywhere, and not a moment to lose. There may be a bag to sort and drop before the train has accomplished the first dozen miles of its journey. Our letter is amongst the heap lying ready to be operated upon; it will be got ready by-and-by, and towards the gray of the morning it will be dropped at some little roadside station, whither the mail-cart driver has driven half-a-dozen miles or more to receive it. Thence to the Post Office, another half-a-dozen miles; and here again the familiar process of unpacking, re-sorting, and re-stamping. Our letter is not for the town at which the bag is opened, but for one of its outlying villages; and the rural postman must be called in before the transaction, commenced in London some ten or twelve hours previously, can be completed. Away he goes, ere yet it is daylight, bag on shoulder, stick in hand, thinking less, probably, of the precious secrets of which he is the bearer, than of his return with a similar, although probably a lighter load in the evening. His life is not exactly one round of pleasure, but an out-and-home sort of journey, in which there is very little real progress, and the 'lettered ease' of which consists in the occasional Sundays on which he is relieved of his burden. He is the final link in the chain which, in shape of men, horses, steam-engines, had to be put in motion in order to deliver our penny letter!

"Letters may be posted at no fewer than twenty-three thousand five hundred receptacles throughout the United Kingdom. How various is the character of these so-called receptacles? Here is the stately Post Office of many of our great towns, situated in the very centre of life and

activity. There the wayside letter-box, far removed from human habitation, and, to all appearance, from human necessity. Lonely roads are no bar to the progress of the rural postman; although the Postmaster-General relates how an attempt to provide postal facilities in a certain district in the west of Ireland was frustrated by a superstitious objection to collect the letters from a wall-box, because 'a ghost went out nightly on parade' in the neighbourhood. Between the stately Post Office and the wayside letter-box there are several different kinds of receptacles for letters: there is the branch Post Office, an offshoot of the parent establishment; the receiving-house, at which a kind of uncovenanted postal service is carried on; and the pillar letter-box, which is dotted about our great towns almost as plentifully as lamp-posts are. In London there are no fewer than eighteen hundred receptables for letters, and of these more than eleven hundred are pillar and wall letter-boxes. The public have a peculiar affection for the pillar-box, thinking probably that it can tell no tales. The writer remembers perfectly well seeing a pillar-box thrown down by a passing wagon in one of the streets of London, and afterwards turned with the 'slit' or aperture downward, so that it might not be used until re-erected. But despite this, it was rolled over and several letters inserted in it while it lay postrate in the gutter! Similarly, letters intended to be 'posted' have often been dropped into the letter-boxes of private firms, and even into the 'street orderly bins' which stand at no great distance from the pillar letter-boxes in the city of London.

"St. Martin's-le-Grand is, of course, the great central depôt for the letters of London, although it is doubtful whether more letters are not actually posted at the well-known branch-office in Lombard-street. Around this spot the bankers and merchants of the metropolis 'most do congregate,' and of necessity the quantity of matter 'mailed' nightly is very large. So is it at Charing Cross, another of the great posting centres of the metropolis.

"Visitors to London are perhaps most familiar with the scene which is to be witnessed any evening between half-past five and six o'clock at St. Martin's. Here the Post Office gapes more widely at its customers, the public, than anywhere else we know of; and here it is prepared to swallow any kind of matter, from the tiniest, flimsiest document, written on 'India post,' to the stock-in-trade of a bookseller from 'the Row' adjoining, or the latest edition of an evening newspaper from neighbouring Fleet Street. Look at the numerous apertures as they gape and yawn in front of you. There is one labelled 'Newspapers,' about as big as a street-door, into which a whole edition of an evening paper might be thrown, without disturbing the calm serenity of the official inside whose duty it is to clear the throat of the monster. 'Letters,' inland, foreign, and colonial, town and country, large and small, thick and thin, may be posted with ease at as many different openings; while the 'stout card' and the thin card, the circular, the book packet, and the sample parcel, each has its appointed mode of descent into the cavernous depths below. What a struggle is there as the hour of six approaches! Burly

office-porters jostle delicate shop-girls in their efforts to to reach the letter-box; tiny office-boys strain and struggle beneath a load which might more appropriately have been conveyed to the Post in a cart or wagon; and hapless youths who have started late, and who have been leap-frogging by the way, are fain to shy their bags or baskets of letters at the nearest opening, and take their chance. Bang goes the clock overhead, and in an instant the box closes with a crash, which must, one would think, have guillotined many a hapless letter, thrown in on the stroke of the hour. Eagerness gives way to disappointment in the faces of those who are in the act of ascending the steps 'as the clock was striking the hour,' for the man in the red coat, whose heart is steeled against all importunities, has pronounced the words 'Too late,' and already the officials at the 'window' are busy exacting the fee of procrastination.* No sooner has one description of posting finished than another begins. Half-an-hour prior to the closing of the box at St. Martin's-le-Grand, the boxes all over London have closed, and the mail-carts — designed rather for speed than for elegance—are rattling into the yard behind, from the various district and branch Post Offices. East, west, north, and south, all contribute their quota to the load which, a couple of hours hence, is to leave the Post Office yard for the various railway stations in the shape of the 'Night-mail down.'

* By extra payment to the official at 'the window,' a letter [illegible]gh some minutes late will be received and despatched.

"The Penny Post has destroyed all distinctions in the great republic of letters. In the eyes of the Post Office all letters are equal, whatever their character, caligraphy, or country; and no rival interests are studied within the walls of St. Martin's. The big letters are not permitted to oppress the little ones, each being tied up in their own particular bundle; and books and samples are so disposed that they are transported with a minimum of inconvenience to their less robust neighbours passing through the post. The work of facing—that is, putting all the letters with their addresses one way — stamping, dividing, sorting, and despatching, is performed in regular succession, as the letters are cleared from the box; for it is needless to say that all the operations of the Post Office are carried on with clock-like regularity. In the old coaching days, when letters were despatched they were said to be sent 'down the road;' and the term 'road' is still retained in the Circulation Office, as indicating the particular desk or division at which the bags are made up for particular lines of railway or districts of country.

"Eight o'clock is the hour at which the great night-mail is despatched from London; and the scene, although perhaps less stirring than that of the old mail-coach days, is sufficiently curious to attract a large crowd at St. Martin's-le-Grand. Gorged with the accumulated correspondence of four millions of people, the huge building, now used exclusively for the sorting and despatch of letters, begins to exhibit palpable signs of discomfort as the hour of eight approaches; and ever and anon from the floors above come

shooting down on to the platforms by which the building is surrounded on three sides, sackfuls of letters and newspapers, which are quickly transferred to the gaping mail-carts and waggons ranged underneath. Gradually the descent becomes fast and furious, until at five minutes to eight every aperture in the building is seen to belch forth its bag, box, or bundle of letters; and cart-drivers are shouting lustily to make way for 'Her Majesty's mails.' Away go the carts, vans, and omnibuses—a whole string making for Euston with the load of the 'Limited,' which seems to be limited in all else save letters; and others making for the different railway *termini* scattered all over London. A few minutes later, and there emerge from the building hundreds, we had almost said thousands, of busy toilers whose work has just preceded them; and in less than half-an-hour silence reigns supreme in and around St. Martin's.

"Letters are not always so plainly or so correctly addressed as they might be. This is a truism which most people will be inclined to reject as beneath their notice; and yet it is a truth which is painfully thrust upon the officials of the Post Office every hour of the day. Think how the circulation of a badly addressed letter must be impeded at every stage of its progress! Let us suppose that a righteous fate overtakes it at the very outset, and that it 'sticks' in the aperture of the letter-box and loses a collection. Let us suppose, further, that it is addressed to 'George Street, London,' simply. There are *only* twenty-three streets of the name in the metropolis; and it so

happens that there is one or more in each of the eight postal districts! Thus, then, a letter so addressed might have to be sent all over London before reaching its destination; and who shall say that the fate was not richly merited? Much the same kind of thing would happen to a letter addressed to 'Queen Street, London;' there being no fewer than twenty streets bearing the title of our most illustrious sovereign, besides squares, crescents, gardens, terraces, rows, and roads innumerable. Quitting London, however, we will suppose a letter addressed to 'Newport' simply. Is it intended for Newport, Monmouth; Newport, Isle of Wight; Newport, Salop; or for any of the remaining four towns in England, two in Ireland, and one in Scotland, which flourish under that name? So too with Ashford, of which there are four places of the name in England; Bradford, of which there are three; Broughton, seven; Burnham, five; Burton, fifteen; Bury, four; and a host of others which we need not stay to enumerate. The Post Office regulation on the subject of addresses runs thus: 'Every address should be legible and complete. When a letter is sent to a post-town, the last word in the address should be the name of that town, except when the town is but little known, or when there are two post-towns of the same name, or when the name of the town (such as Boston) is identical with or very like the name of some foreign town or country. In such cases the name of the county should be added.' Very good regulations these, but unfortunately they are not always attended to by the sorting clerks. We are constantly getting letters which have been

delayed in their journey by the perverse stupidity of sorters mistaking the address, however plainly writtten, and in fact not attending to the name of the post-town. There are some other grounds for dissatisfaction. In numberless instances, towns near each other hold no direct postal communication, and letters between them make a long round before reaching their destination. These are blots on an otherwise wonderfully perfect system."

This writer has not, in the present instance, done—as we know he could well have done—given some indication of the work of these clever and useful officials, who, with the strangest perversion of language, are called "Blindmen." The "blind" really, however, as we suppose, applies more to the matter on which they are employed than to them. It is their business to decipher bad writing, to guess at imperfect addresses, to trace out missing links by aid of directories, and so on; and sometimes they achieve wonderful successess. We shall have some specimens of what they can accomplish in a moment; meantime we only remark that such letters as the "Blindmen" cannot, with all their leisure and resources, make anything of, pass on from their hands, to that of the Dead-Letter Office, there to be dealt with according to the well understood routine.

Only fancy the look of a sorter on receiving into his hand a letter from America, addressed :—

"LITTLE ALICE,
"Serio-Comic Singer,
"London,
"England."

Yet, by aid of the "Blindmen," the letter reached its destination without much loss of time; or, better still, this from Versailles:—

"Please to put,

"This young man,

"in the right

"Train for Penge,"

which, however, was more difficult to deal with: the poor young man having evidently been instructed by some ignorant or careless person to put his "direction" into a Post Office or Post-pillar; and was, doubtless, much *moved* by it afterwards? Here is another testing case:—

"This letter is for Mrs M. ——. She lives in some part of Liverpool. From her father John —— a tailor from —— ——; he would be thankful to some postmaster in Liverpool if he would find her out." The Post Office does sometimes achieve wonders in discovering the persons to whom such letters are addressed: but this was really beyond its powers, and the letter was sent to the Returned Letter Office.

In 1877, nearly 28,500 letters were posted without addresses, being an increase on the previous year of about 2000; 757 of these letters were found to contain in the aggregate £214 12s. 5d. in cash and bank-notes, and £9088 11s. 11d. in bills of exchange, cheques, &c.

Not seldom blame is attached to the Post Office for loss of letters when none of the blame should be borne by it. Not to speak of letters which have never been posted and are found afterwards in the pockets of garments long

since laid aside, nor of the perversion of messengers for the sake of the stamps and other reasons, unexpected and curious instances of malversation are constantly being discovered. Here is one from a recent Report:—

"Complaint having been made last year that certain letters which ought to have reached a bookseller in a country town had not been received, it was concluded, after inquiry, that they had been duly delivered, but had subsequently been withdrawn from under the street-door, which was furnished with a slit to receive letters, but without a box to retain them. During recent alterations in the shop, however, when it was necessary to remove the flooring under the window, discovery was made of thirty-one letters, six post-cards and three newspapers, which had been carried thither by rats. The corners of the letters, &c., bearing the stamps, had been nibbled away, leaving no doubt that the gum upon the labels was the inducement to the theft. Several of the letters contained cheques and money-orders."

Strange, indeed, are the contraband articles which day by day find their way into the Post Office. Living creatures are probably the most objectionable. Wearing apparel, flowers, fruit and vegetables, models of metal fittings and toys, might be put up with; but silkworms and spiders, leeches and snails, white mice, sparrows, snakes, crayfish, and dogs are not so inviting. Snakes have, in some instances, escaped their enclosures and been found wandering in the offices; in one instance a snake totally disappeared, and could not be recovered: in another case a snake and a

lizard were enclosed together, and, under regulation, retained; in the morning it was found that the lizard had disappeared; and it was presumed that the snake had made a meal of it. On one occasion, in 1875, a dog was posted at the Lombard Street Post Office, and having fallen into the bag affixed to the letter-box was not discovered until the contents were turned out at St. Martin's-le-Grand.

At the beginning of 1879, a reduction in the cost of registration from 4d. to 2d. was introduced, which led to a great increase in that department—the first quarter of 1879 showing an increase of 82·1. A rule coincidently came into force, under which undelivered letters which contain money or other valuables convertible into money, are returned to the senders, and a registration fee of 2d. charged for them. The number of letters thus returned was 38,311. The advisability of this rule is evident for two reasons, registration is so cheap that it should in all such cases be resorted to, and, next, it is better to put few temptations in the way of sorters and letter-carriers.

It is very odd to hear of the devices that are still adopted to evade registration. Coins are embedded in cake or pieces of toast. Sovereigns are sent in layers of brown paper, then done up in parcels. A £20 note was found pinned to the pages of a book, and a halfpenny wrapper was found to contain a letter, a bill of sale, and four £5 Bank of England notes.

Notwithstanding the great depression of trade, the number of telegrams has increased; and though the Money Order transactions showed a decrease in the number

and extent, yet this business showed a profit to the department at the end of the year 1878-9, of £39,027, against £6420 in the preceding year. The Post Office Savings Bank also shows considerable progress, doubtless due, in part, to the failure of other banks bringing before the masses the great advantages in the security of the Government Savings Banks. Some of the more out-of-the-way statistics may be given.

At the end of 1876 there were 1650 unclaimed books in the possession of the Department, representing a total amount of £1,333 5s. 4d. These stray books have accumulated during more than fifteen years under varying circumstances. Many of them have come from Post Office Savings Banks, where they have been accidentally, or otherwise irregularly, left by depositors, and never afterwards applied for; while others have been forwarded by persons who had picked them up in the streets or elsewhere, or into whose hands they had fallen in ways more or less peculiar.

But for the most part they are books which, having been forwarded from this Department after examination, could not be delivered, owing to the depositors having changed their places of abode, leaving no clue behind them.

What, we think, is calculated to become an important adjunct of the Post Office Savings Bank System, we deeply regret to see, has as yet been but slightly taken advantage of. This is the arrangement, sanctioned experimentally in March, 1878, by which managers of Penny Banks in remote villages may, by means of a system of free registered letters, assist the depositors in Penny Banks to open and

to continue accounts in their own names at the nearest Post Office Savings Bank, without personal attendance. Only in two instances had it been taken advantage of in December, 1878.

It is with feelings of a very mixed kind that we read at this date such a paragraph as the following—celebrating advantages which have since been unavailable—their cessation associated with exceptional gloom and sorrow:—

"The opening of the Tay Bridge at Dundee by the North British Railway Company has afforded facilities for improving the Mail Service between Edinburgh, Dundee, and Fifeshire generally. Thus the morning train from Edinburgh through Fife now reaches Dundee in time for the correspondence from Edinburgh and Fife to fall into the second delivery at 9.50 a.m., instead of the third at 12.15 as formerly; and the afternoon train from Dundee arrives in Edinburgh for a delivery of letters from Dundee and the chief towns of Fife the same evening instead of the following morning."

The realisation of an Ocean Penny Postage, for which the good and great Elihu Burrit, amongst others, so energetically worked, is still a thing of the future. But doubtless it will come in time. What, at one period, seemed every whit as impracticable is now matter of every-day convenience, of which we all share the benefit, without ever thinking of the slow and difficult process by which it was attained. One step indeed in this direction has been already made by the International Postal Union, through which nearly all countries enjoy the privilege of communicating

with others at the uniform rate for a light letter of $2\frac{1}{2}$d. And after that, the Ocean Penny Postage seems an easy step in succession to the steps that have been already taken.

One thing alone we must add, that to perfect the system for the public benefit it remains that all profit from it should be devoted to it—devoted to the still further reduction of rates and the still further multiplication of offices and means of speedy conveyance; first, cheapened telegrams; in *London*, the use of the pneumatic tubes—at least of those already laid down—for "closed telegrams" one-half the price fixed for actual telegraphing; a cheap parcels post, and yet greater facilities for registration.

It is very hard that the results of some errors in the past should stand in the way of reforms, which would infallibly bring so much profit to the country, both direct and indirect. If but a fraction of what is spent in various forms of jobbery at home, and in special missions of special commissioners (who, in any other calling, would scarce be able to earn their bread), empowered, by exercise of the lowest and most contemptible craft, to embroil the country with tribes on our borders, were but for one year devoted to wiping off certain embarrassments, we then should have such a postal service as would render us, what we should be, a pattern to other countries. As it is, we do lag behind and do not lead.* Let Mr Fawcett consider this; lean little to the advice of clerkly officials, interested only in maintaining things as they are—as the history of the Post

* See Appendix.

Office amply proves they have always been,—and let him, by judicious forecast and independence, do what England and the world will bless him for, instead of settling down on the lees of routine and use and wont and failure.

Since the above was written, Mr Fawcett has clearly indicated the spirit in which he means to carry forward the work of postal reform. Various circumstances concur to render it difficult for him at once to do all that he would; one of which is the tradition that the Post Office is but a subordinate branch of the Treasury—a bad principle at the best, and one that we believe to be as impolitic as it is really unpractical. The whole history of the Post Office proves that it has progressed, and has also paid best, under the distinct application of the principle that it exists first for the public convenience and service in its own line of work; and that the Exchequer will really fare the more fortunately the more liberally and disinterestedly the Post Office comes to be so regarded. It is but another illustration of the axiom that "best things sometimes come without the seeking for them alone." No doubt there are limitations and necessities laid on every department of the public service in relation to other departments, which practical politicians at the head of affairs cannot overlook; but Mr Fawcett's reforms are distinctly in the spirit of our principle rather than in that of the traditional one. The immense facility he has given for the deposit of the smallest sums with the Savings' Bank department; the opening of

female clerkships to free competition, thus bringing practically within the kindly scope of the public service a wider sweep of classes—these are both directly illustrative of it; and we are indebted to Mr Fawcett also for one of the most earnest pleadings on behalf of common-sense as against a false English gentility with respect to strong prejudices felt about certain kinds of honest and useful labour. His words, in that regard, let us hope, will bear much fruit in time to come, more especially as being spoken by one who, in his own person, is a bright example of triumph over difficulty, and we may even say prejudice, in his own particular sphere.

THROUGH TRAFFIC.

THE Post Office and the railway are the great arms of the commercial system. Without them power were incalculably reduced and time irrecoverably lost. They bring remote places near, and practically annihilate distance. To endeavour to come to a better understanding of their workings will not, therefore, be regarded as inconsistent with the scope of this volume, but the reverse. Certainly if goods could not be conveyed at the rate of forty miles an hour, only one-half, perhaps only one-fourth, of the business that is now transacted could be done. We have tried to do justice to the Post Office and the telegraph system; and now we shall peep behind the more obtrusive machinery with which travelling makes the most unobservant persons acquainted, and try to reach the principles which practically transform all the prominent railways of the United Kingdom into one great system for the unspeakable benefit of all; and we doubt not we shall be successful in catching here and there a fact not generally known. We shall, at all events, faithfully try.

If the reader takes up a railway map of the United Kingdom, he will at once see that it is hardly possible to travel a long distance without passing over several lines of railway, the property of different companies. In going from London to Inverness, for example, the London and North-Western, the Caledonian, and Highland lines are traversed. Or, if the East-Coast route be taken, then the Great Northern, the North-Eastern, the North British, the Caledonian, and Highland railways are used. In going from Darlington to Cardiff the North-Eastern, the Lancashire and Yorkshire, the London and North-Western, and the Rhymney Railways are passed over; while between Lynn and Inverness there lie no fewer than six different lines. Has it ever struck the reader to inquire how it comes that, in spite of these facts, he can book through from London to Inverness, or from Lynn to Stirling, or even to Dingwall, without the trouble of taking out fresh tickets at the junctions? Imagine the wholly different aspect things would wear for the railway-travelling public, if each company only booked over its own line; the constant worry of changing, the bustle of re-booking, the hunting up of luggage, and the conveying of it from station to station, it may be at considerable distance from each other; for unfriendly railway companies might not of themselves court close proximity in their termini. It is evident on the face of it that a stop would at once be put to extended excursion tickets, to circular tours, and to all that elaborate system of easy holiday travelling which is, year by year, becoming more and more a necessity of our modern life at

high-pressure. And bad as it would certainly be for passengers, it would yet be worse for goods traffic. Indeed, it is difficult to see how, under such conditions as we have supposed, with constant unlading from waggon to waggon and cart to cart, the millions of tons of goods of all kinds could ever get to their journeys' end. Certainly, for the class of goods coming under the head of "perishable" there would not be much chance. Yet such would inevitably be the position, both for goods and passengers, were there not in existence an institution, supported by the railway companies, yet in a sense apart from them, which unites them as though into one body, notwithstanding divergent interests at many points, at once for their own ultimate benefit and for the unspeakable comfort of the community. Seeing that all are so largely indebted to a machinery which, on the whole, is so little known, we cannot but believe that our sketch of this system will be read with interest by not a few.

In Seymour Street, Euston Square, London, there is a compact-looking, but somewhat dingy building, with another "fresh from the mason's hand" close to it, known as the Railway Clearing House. It is in this establishment that the magic work of booking through is really accomplished. Here are a staff of some fourteen hundred clerks, who, under a secretary and four chief clerks, may be said to supervise and adjust all the Through Railway Traffic of the kingdom, there being but a few miles of straggling local railways which are not in connection with it. In addition to this staff at the head office, there are

about four hundred agents or "number-takers" who are placed at the various junctions where the lines meet. The duty of these agents is to take note, by name and number, of every carriage, waggon, and cover-sheet that may pass on to a foreign company's line, and the date of such transfer. Accounts are regularly forwarded by them to the Railway Clearing House, and these reports, together with passenger tickets and returns regularly forwarded from the stations themselves, furnish the materials from which the staff of the Clearing House busily work out their results day by day. The first process to which this chaotic mass of documents is submitted is that of "sorting." For this a detachment of messengers is retained, who refer each paper to its proper chest, from which they are conveyed by boys to the various departments, of which there are four, with many divisions.

The first and by far the largest department is that of *Merchandise*, which may be said to comprise the half of the whole work of the House. This takes cognisance of all Traffic distinct from that of passenger trains; and the main features of the process are easily indicated. Each station makes return of all its outward Traffic wholly distinct from that of its inward Traffic; and the first piece of work is to check the outward returns of the forwarding station with the inward returns of the receiving station. In the case of any discrepancy, of course, it is necessary that the stations should be corresponded with, and the returns rectified; and not seldom much trouble is involved in this. If, however, the returns are found to correspond

exactly, the next step is to make due allocation to each company. But before this is finally done, it is necessary to settle the matter of "terminals"—that is, the allotment of allowances for the Despatching and the Receiving Company, including collection, cartage, loading, unloading, delivery, &c. This having been deducted from the total, each of the companies concerned is then credited in exact proportion to the mileage of their lines over which the goods have been conveyed. This would seem to be on the whole a very simple matter; but it is complicated by many special arrangements; and in not a few cases the routes over which the commodities may have travelled cannot be learned from the station returns. In this event their route must be traced out by reference to the numbers of the waggons in which they were sent. This is ascertained from the returns made by the number-takers at the various junctions. Besides, there are different working arrangements. In some cases the goods are hauled and in others not hauled by companies over whose lines other companies have running powers. Between Brighton and Aberdeen, for example, a waggon must pass over a portion of the London, Chatham, and Dover and Metropolitan lines, from Battersea to Ludgate, and from Ludgate to King's Cross; so that, while the Great Northern must be credited with the hauling over these lines, the companies themselves must be credited with the due amount for the wear and tear of their metals. As the last outcome of the work in this department, the accounts of the companies are so made up as to show at once how much money is due to or

from them, both inwards and outwards, at the end of the month, and how much each company has to receive from each of its station agents. In the event of loss, say, by the failure of a trader, the same principle is applied. The Clearing House allocates to each of the companies concerned its proper proportion, which, as in the other case, is implicitly accepted by them. So, too, in any dispute that may arise. The Clearing House acts the part of a neutral, dividing the undisputed portion of the receipts, and holding the rest in trust till the parties agree.

Broadly taken, we have this as the result of the Clearing House work applied to merchandise, that any station on any railway can invoice and forward goods to any other station in the country to which through rates have been agreed, and the companies need not in the least trouble themselves over the proportions of the rates charged, assured as they are that this will be accomplished for them. We have, in a very complete account published in the *Railway Flysheet*, the following apt illustration of the exactitude of the process of tracing out details and balancing accounts:—

"When a city man returning to his suburban retreat passes a goods train composed of Great Northern waggons (carrying goods from various towns in the north of England), hauled by a North-Western Company's engine, on the North London Company's Railway (if it ever strikes him to think of the matter at all), he must imagine that it is utterly impossible that each company concerned should ever get its correct proportion of the receipts from the

carriage of the miscellaneous consignments of goods which it contains, and yet it is a fact that the Clearing House accounts are made up with such minuteness of detail, and facility of reference, that any error, however small the amount, can be easily pointed out and duly remedied."

The next department takes the name of *Coaching*, and is concerned with everything carried by through passenger trains, animate and inanimate. It is divided into two sections—parcels and passengers. Of the work of each we shall give a general outline.

(1) *Parcels.*—It is clear that as the greater number of parcels so carried are comparatively small, no trace can be kept of them by the numbers on the vehicles they were conveyed in, as in the case of goods. It is therefore necessary to have a regular system of way-bills, with an efficient check at each junction; and this has been found to a large extent in perforating stamps. If the parcels and the way-bills have kept together, all is easy; but if they should chance to get separated, as in busy times will not unfrequently occur, through the haste or ignorance of porters, a great deal of work is imposed on the Clearing House in tracing out and identifying them. Here, too, a certain amount is allowed for collection and delivery, and the remainder equally divided according to the mileage. We should mention, however, that for parcels the terminal allowances, for a reason easily guessed, are at a fixed rate per parcel; the receiving company getting double the allowance of the forwarding company. Accounts are made up in a manner somewhat similar to that of the

merchandise department, and with the same exactitude, only that the actual division of receipts is here half-yearly instead of monthly. Notwithstanding their smaller scale, we can well believe that the compilation of these accounts is a yet more complex and tedious matter than that of the goods accounts.

(2) *Passengers.*—Our readers will not have failed to observe that on "through tickets" there are not only a very plentiful amount of numberings, but that at each junction a process of perforating is carried on, which toward the end does not seem to improve the symmetry of the valued bit of cardboard. These marks each mean something important to a Clearing-House clerk. The tickets run in regular order of numbers; so that the first thing done in the Clearing House, after all the tickets have been arranged by some twenty-five boys constantly employed at this task, is to ascertain that the commencing and the closing numbers issued for the month by the ticket-clerk exactly agree. The perforated marks again show to the experienced eye at a glance whether or not the proper route, or what route has been taken. The ticket-clerk has forwarded to the Clearing House the halves of the children's tickets that were reserved by him at the time of issue, and these having been allowed for, as well as any omission of issue that may have been detected, the preparation of the companies' credits is begun. These show for each company interested full particulars of the progressive numbers, the non-issued and children's tickets, the number of tickets sold, and the pro-

portions of the fares due to the company for whom the account is prepared; each return, as entered, has to be balanced so as to ensure the total of the credits in the various accounts agreeing with the total station debits. A similar course has to be adopted with other station returns, and it consequently results that a company is a debtor for the fares it has received on account of other companies, and creditor in respect of the fares other companies have collected on its behalf. A complete check, as will be seen, is thus not only kept up as between the various companies, but as between them and their various employées.

The next is the *Mileage* department. Though the amount of money cleared by it is small compared with that of the other departments, it is, in some respects, the most important of all. It really constitutes the foundation of a great part of the Clearing House system. It deals with the rolling-stocks of the various companies, carefully follows each item, and ensures speedy return. In the early days of railways, constant difficulties arose about carriages and waggons. Many of them were kept possession of for weeks and months, and were greatly injured; some, indeed, were never traced, and were entirely lost to their owners. It is here that the main purpose of the number-takers at the various junctions comes into full view. Every carriage, waggon, and sheet passes under their scrutiny, is made careful note of, and followed in its course from the beginning of its journey to the end; the one number-taker checking and supplementing the other. On their reports the Railway Clear-

ing House credits the owning company of each carriage or waggon with an agreed rate per mile the moment it passes to another line. The London and North Western, for example, send their Through Traffic over the Caledonian line, and the mileage charged for their "foreign carriages," as they are called, is settled at three farthings per mile. At the end of the month the bill for mileage against the North-Western will amount, say to £8,000; but, on the other hand, there is a *per contra* in the form of mileage against the Caledonian, which has also been sending carriages and passengers over the London and North Western, and both accounts go to the Clearing House. Taken together, they may amount to about £20,000, yet the set-off of the one against the other may be no more than £10 or £20. Again, should the stipulated time have been exceeded before the vehicle is returned to the owners, a demurrage charge per day is made. The rates of mileage and demurrage are of course to compensate the owners for the wear and tear of their stock while in the hands of others. Thus, if a first-class carriage be sent from Euston to Edinburgh, the Scotch Railway is bound to return it to Euston at once, whether full or empty. If it is not sent back 10s. a day is charged against the company retaining it, and so on down to second and third-class carriages and to waggons, which are only charged 3s. a day. The mileage charges are made quarterly. On one side of each balance sheet is shown the charges due from all companies, to the owners of one stock, on the other the earnings of all stocks on

the line of one company. And, as we have said, the difference is then either received or paid by the Clearing House.

The number of miles charged through the Mileage Department per annum is about four hundred and thirty-nine millions; the number of days upon which demurrage is charged is upwards of one million, involving yearly nearly twenty-nine millions of entries.

A most important department of the work of the Clearing House is that connected with *Lost Luggage.* Every station is required to report at once to the Clearing House, with exact details, the presence of any unclaimed luggage, and all inquiries made by passengers for missing luggage are at once forwarded to it from the various railway offices. The descriptions are carefully compared, and the finding station instructed how to dispose of the property; the Clearing House again being advised that it has been duly received at the station where it should be delivered to its owner. The value of this department to the public can hardly be over-rated. Officials are fallible, and mistakes are most likely when Traffic is greatest; and the companies have shown wisdom in thus providing a central department where the matter can be thoroughly and expeditiously dealt with. Scarce anything is more distressing than the loss of personal luggage; but those who happen to be unfortunate in this regard may take heart, for few absolute losses are experienced—so thorough is the Clearing House system. Over one hundred and fifty thousand packages are annually restored to their owners—many of them doubtless

containing valuable articles. Being, however, nearly all locked portmanteus, dressing-bags, carpet-bags, and trunks, it is impossible to estimate their worth exactly, but half a million sterling annually would be quite within the mark.

This great establishment is managed by a committee appointed from the directorate of the different railways. The chairman is Lord Wolverton, whose father, Mr Carr Glyn, was one of its first supporters, and did much to reconcile the railway companies to it, while as yet they were slow to see its merits and its great capacities of growth. The administration is in the hands of Mr P. W. Dawson, who has been fortunate in seeing it rapidly "grow from more to more" under his hands in recent years. In 1842, when it was started by Mr Kenneth Morison, in Drummond Street, it had only five clerks; in 1866 it had upwards of four hundred; to-day, as we have seen, it has over fourteen hundred. Three years after its institution, there were only sixteen companies on its books. Ten years later there were seventy-three. Now, as we have said, there are only one or two small unimportant lines not connected with it, while it embraces many lines of steam-boats. The total extent of lines under its jurisdiction in December, 1874, was 15,400 miles.

In addition to the fixed conferences of the delegates from the railway directorates, regular meetings take place of the managers of the various lines to arrange any differences that may arise with respect to particular points; and special meetings are called in the event of any question

coming forward of immediate and pressing importance. For all these arrangements, by which a settlement is ensured without delay, and without such disturbance of friendly relations as might soon come to affect the public comfort, we are indebted to the Railway Clearing House, which prepared the way for this amicable relationship, and has managed to maintain it.

"The plan of the Clearing House," says the *Times*, "is simple in the extreme. It may be said to represent the combined interest of the railway companies united in a voluntary association under the provisions of an Act of Parliament. No company is obliged to join it unless it chooses, and any company can withdraw from its association at a brief notice. Practically, however, this permission to withdraw is of small avail, for no company can really conduct its business without the assistance of the Clearing House. . . . What has always been desired by theorists—namely, one vast amalgamated general railway system—has been virtually brought about by the labours of this Clearing House, with this difference, that as each line has its representative on the Clearing House committee, each member looks after the interests of the line from which he is accredited with a vigilance which no merely central board could ever do. In fact, a central board would be nothing but a gigantic monopoly full of prejudice and hostilities, and without much motive to either economy or efficiency. In such a case the division of labour became the only element of success. The lines being distributed among a number of proprietaries, the energy of different

boards of directors, the watchfulness of the various bodies of shareholders, and the wholesome emulation between the companies, are all brought to bear through the Clearing House on the successful working of the lines, and the public derive the benefit of a Through System of Booking as if there were only one railway company and one set of shareholders throughout the kingdom. . . . Our old railway system would be as nothing without the Clearing House, which affords another illustration of the great truth that the British railway public is the best served railway public in the world, and, on the whole, the least grateful."

The much abused railway director, however, is in this seen to be wiser in his generation than he generally gets credit for. For here he has his disputes settled by committees of delegates who are chosen for the purpose, and who determine which company is in fault for damage, claims for delays, &c., &c. Heavy law expenses are thus saved, and those concerned have the satisfaction of knowing that whoever loses, railway companies and not lawyers pocket the cash. This, we are inclined to think, is a great feature in the usefulness of the Railway Clearing House.

In connection with the establishment there are various benevolent and other societies, which show the warm interest taken by the heads in the moral and intellectual condition of those under them, as many details in the arrangements of the rooms decisively show that health and physical comfort have likewise been well considered. The most prominent of these are the Contingent and the

Superannuation Funds, both organised on an admirable basis. The latter, which is open to all railway companies, parties to the Clearing House, was established mainly through the exertions of Mr Dawson, after similar schemes had repeatedly fallen aside. The subscription is two and a-half per cent. upon the salary of the subscriber, his company or committee subscribing the same amount. There are about two thousand members, and an accumulated fund of about £20,000, five railway companies having joined. We were much pleased, also, to see that, through the liberality of the directors, the staff of the Clearing House are in possession of an admirable library of over eight thousand volumes, to which a permanent librarian is attached, also of a reading-room, well supplied with newspapers and magazines, where lectures and entertainments of varied character are given during the winter months. They are also provided with handsome kitchen, luncheon bar, and dining-hall, in which cheap but substantial dinners, luncheons, teas, &c., are provided daily for upwards of a thousand clerks—an arrangement which doubtless does something to maintain the admirable sanitary condition of the House. There is also a co-operative store, which, like the dining-hall, is managed by a committee of the clerks.

APPENDIX.

Just as we were sending the last sheet of this volume to press, our eye fell on the following article in the *Scotsman* of September 21, 1880, which, we believe, the Proprietors of that journal will not object to our inserting by way of an Appendix, to indicate *some* of the details in which our Postal system is still susceptible of improvement:—

DEFECTS IN THE POSTAL SERVICE.

The opinion that the British Post Office service is the best in the world is so general in this country that it may seem a bold, if not even an ungracious, task to hint to the contrary. Undoubtedly the opinion is a correct one, if only the broader lines of the policy pursued by the Post Office Administration are looked at. We gave the world the idea of cheap postage, and in that respect we still hold a high, if not indeed the highest, position. Nowhere is there to be seen a service so rapid or so thorough as that represented by the great trunk communication, of which the "limited mail" from London to Perth, and the splendid service *via* Holyhead to Dublin, are the most prominent features. In its allied branches of Money Order and Savings Bank work, the Post Office here shows completeness of organisation and admirable administration. And when we look at the vast systems by which our distant colonies

and dependencies are kept in communication with the mother country, we see an amount of enterprise and thoughtfulness which, despite some obvious flaws, has neither equal nor rival in the world. Yet, while all this may be admitted, and some degeee of pride may be felt in what has been done, the very thoroughness and completeness of what does exist bring all the more into prominence some points of detail in which our Post Office system undoubtedly falls short—points where the example of other countries, as well as the dictates of common sense, show that improvement is urgently called for.

To take, first, the case of the rural posts: of what use is it that our railway trains should be the swiftest and most regular in the world if, when the letters have been carried at express speed over one stage of their journey, the letters are not, after all, delivered to the person to whom they are addressed? In towns, and even in the smaller villages, we have the blue-coated postman coming to every man's door; and, although there is a tendency to assume, throughout the length and breadth of the land, that the London mail is of principal importance—an assumption which local circumstances frequently render absurd—the postal delivery in such places is generally in a satisfactory condition. But the delivery in remote country districts is as often as not so arranged that, instead of a convenience, the approach of the post is an irritation and an annoyance. Cheapness being all in all, the bearers of letters are in too many cases made to pursue a straightforward course, turning neither to the right hand nor to the left, so that residents in remote hamlets, and sometimes even in important country mansions, have to make an arrangement to send for their letters to some cottage or toll-house where they have been by arrangement left. It has been, we believe, estimated that, as a rule, this hardship arises because nine men only are engaged where ten are really required. The addition of a few hundred men would cure the anomaly, and save us from again being told that "Britain is the only country in Europe where letters are not delivered where they are addressed." Would an addition of £50,000 to the Post Office estimates to secure this end be deemed an unreasonable thing by the most rigid economist in the House?

When, about a year ago, it was pointed out, in discussing the Postmaster-General's last report, that every improvement had been forced on the Post Office from without, a correspondent drew attention to an accommodation enjoyed by "the pettiest hamlet in the Black Forest," but which, except in Liverpool, and recently in one or two places in Edinburgh, is unknown in this country. We refer to an indicator on the pillar letter-boxes to show whether or not the letters for a particular mail have been removed. The usefulness of this simple contrivance has been seen and felt in Liverpool, and there it is understood to have proved as useful, in a disciplinary sense, for the Post Office people as it is beneficial to the dwellers in the suburbs. The point is this, that while half-a-dozen pillar-boxes may be marked to be cleared out at the same hour, one man cannot be at them all at once, and a person arriving at the box say, a minute or two after the time, cannot say, at present, whether or not he has missed the mail. But to this day the ever-increasing number of pillar-posts remain without this simple and obvious improvement.

In a recent number of *L'Union Postale* (the official organ of the Universal Postal Union) a description is given, with diagram, of an arrangement for the greater accommodation of rural districts, which has existed some years in Germany, the home of postal reform in recent days. Two towns are on a line of railway. From each of them a man travels into the country, making a circuit, the two beats nearly touching at one point. But a letter posted at A for D must at present be carried from A to B, thence to C, and the next day to D, a period of thirty-six hours elapsing. By slightly extending the walk at A and D, so that the men would touch at a common centre E, an interchange of all the local letters might be made, and many hours saved. The editor of *L'Union Postale* points out that the principle of this rural interchange might be applied in many detailed combinations, and we may add the opinion that it would add to the convenience of the public as well as to the postal revenue.

In the details of reforms which our postal system calls for, it is not a little singular to know that, should the "reply paid" post-card be introduced into this country (of

which, however, we have no present expectation) we shall only be *eight or nine years* behind Germany in the adoption of this improvement. The existing single post-card was proposed in 1865 by M. Stephen, Postmaster-General of the German Empire; but it was not till 1869, when Dr Hermann of Vienna, again broached the proposal, that it was first introduced, Austria having the credit of leading the way. Two or three years sufficed to carry the system over the principal countries of the world, the British Post Office having adopted it in October, 1870; while other nations followed with more or less rapidity. But in January, 1872, the German Empire adopted the prepaid answer card (*Postkarten mit bezahlter Antwort*), while Belgium, Italy, and other countries followed suit. France, which adopted the answer paid card in July of last year, found itself at that date enjoying that privilege in common with Roumania, the Argentine Republic, Portugal, &c. But where is Great Britain in the list?

Reference has been made above to the general excellence of our Post Office Money-Order system; but those who have only looked at the matter as it is presented in the arrangements of the British Post Office, can have very little idea of the many ways in which the system has been developed in other countries. In Scotland, we have had one attempt to carry out a new feature in steamboat postal work, in the collection and delivery of letters and telegrams on board the large West Highland tourist steamers. But this, excellent in itself, was only an adaptation from abroad, as one may learn from the fact that, in September last year, the French Postal Administration arranged, in the interest of travellers by the French mail steamers, that the maritime postal officer on board should receive from passengers money to be sent to any part of France or Algiers; and, on the same day, these officials were authorised to collect subscriptions to newspapers on board, for transmission in the same way. Perhaps it would be the case that the leading newspapers in this country might not favour this latter proposal. It has, however, met with much acceptance on the Continent, and is but one out of several similar duties undertaken by the Post Office there. There was, for example, a convention for the interchange

of Money Orders by telegraph between Switzerland and the Netherlands brought into operation a year ago. In this country, even inland transactions of that kind are not undertaken, although the companies which preceded the Government administration of the telegraphs did so. In December last, the Belgian Post Office undertook the collection of bills of exchange for everybody, having, since May, 1876, conducted this service within a limited range. Recently the German Post Office undertook, for a small registration fee, to accept articles to go by mails about to start so long as any officer remains on duty. Contrast this with the experience in our own city [Edinburgh], where after nine o'clock the Post Office is wholly closed to the public, although inside there is work going on later, and, we presume, at early hours of the morning. By a law which came into operation some time ago, the sender of a Money Order in France can demand an advice of its payment on paying ten centimes, or one penny. In Belgium, in all towns where there are no stamp or tax offices, the Postmaster has been charged with the sale of all categories of stamped paper. In British India the Post Office accepts "value-payable" letters—that is, packets on which sums of money are to be collected on delivery and afterwards paid over to the senders—at a rate of commission which on the first of the present month was reduced one-half, so successful has the system been. The charge is two annas (3d.) for ten rupees, or one rupee for a hundred—in other words, at a rate of one per cent. on the sums recovered. These are but samples of a class of facilities which have been growing in other countries, while our Post Office stands comparatively still, contenting itself with the notification to the public in a recent Postmaster-General's report, that certain international proposals from France and Germany had been rejected as "incompatible with the Money Order system in this country." The people of this country are not so enamoured of our iron-bound system that they would have objected to a modification which would have put our Money Order facilities on a par with those of France and Germany.

II.

CHROMATE LEATHER.

Probably recent times have not furnished a more striking illustration of the truth of the Prince Consort's words, which we have chosen as motto to this book, than the recent invention of Chrome-Tanning, which is due to Dr Heinzerling, of Frankfort-on-the-Maine. Since our opening chapter on Leather was written, the Leather trade of this country has been not a little exercised by his new process, which promises, before long, very considerably to alter the conditions of trade. This process has for its main objects the shortening of the time needed and a reduction in the cost of tanning all kinds of Leathers. This it seeks to achieve by the substitution of a chemical element for bark. Many efforts, as we have seen, have been made to supersede the use of oak bark, in order to shorten the period during which Leather must lie in the pits, causing a severe tax on the capital of the tanner. Séguin, the French chemist, and Sir Humphry Davy, in their various experiments in tanning had this end distinctly in view, and since their day the efforts of many chemists and practical tanners have been put forth in the same direction. Nothing, however, was found quite successful—no Leather that had been hurried through the tanning by means of strong chemical solutions, was found to work well; the reason being simply that the action of the compounds was to burn or dissolve away the gelatinous texture of the underskin rather than to consolidate it by slowly-acting astringent properties. The great aim of all tanning, as we have seen, is to convert this gelatinous substance, which otherwise quickly decomposes, into a tough and solid stratum by combination with the tannic acid which is to be found in the barks and leaves of many trees. This tannic acid slowly combining with the gelatine, forms a substance known as tannate of gelatine, which has the power of resisting the ordinary agencies that bring about decay. Oak bark for the strongest and most durable Leathers has really held its place; and the action of oak bark, though sure is very slow, requiring to produce the best Leather from a year to eighteen months or even more.

In *America* certain processes of tanning with hemlock

have sufficed to shorten the period from a year or over to some four or five months; and a good deal of hemlock-tanned Leather has been sent to England; but it is found suited only for the cheaper class of articles. Dr Heinzerling's process supplies a definite chemical element which does the work, in many respects, as efficiently in a few weeks as the oak bark in a year or more; and the fact of such a saving in time and money must be of vast importance both to tanners and those who are in any way concerned in working up strong Leather. For so long as the process involves the use of expensive plant over such a long period, the raw commodity being a high-priced one to start with, the finished product must always be expensive, as well as the articles made of it; hence, any person who suggests such changes in the process of tanning that it can be thoroughly accomplished in a period of from four to six weeks may well be regarded as a public benefactor. The general adoption of such a process as that of Dr Heinzerling indeed, might speedily work a complete revolution in the trade, and cheapen, by one third or more, the price of shoes, in which everyone is equally interested.

Dr Heinzerling has adopted Bichromate of Potash as his leading element; and, as it is produced most extensively in this country, the material lies, as one may say, ready at hand. It has long been known that chromic acid exerts an astringent action on certain animal tissues, more especially the corium or *cutis vera* forming the lower layer of the skin of animals, with gelatine for its chief chemical constituent; but it was left to Dr Heinzerling to show that, in combination with certain other inorganic compounds, it might be used with most marked effect as a tanning material on a large practical and commercial scale. The rationale may be stated in this way: Organic matter in the presence of light has the effect of reducing the soluble Bichromate of Potash into an insoluble Oxide of Chromium, and before this action is accomplished the gelatinous portion of the hide has been rendered similarly insoluble, or in the language of the trade "tanned."

Dr Heinzerling patented his invention in this country so recently as the end of last year, and it was no sooner published than Mr Donald, the Manager of the Eglinton

Chemical Company, Ld., of Glasgow, (one of the leading manufacturers in this country of the proposed new tanning agent), obtained samples of the new leather and tested them, and, realising the value of the invention, proceeded to Germany and visited some of the tanneries there which had already been licensed by the patentee, and verified the claims of the inventor. Negotiations were then opened with the patentee, through his general agents, Messrs Wirth and Co., of Frankfort-on-the-Maine, which have resulted in the enterprising and influential Directors of this Company securing the Patent-rights not only for this country, but also for all the British Colonies and Dependencies, and the Continent of America.

The process is, on the whole, a very simple one; following in main outline the ordinary system of bark-tanning. Its simplicity must prove a great point in its favour; and no doubt weighed with Mr Donald, who seems to take a keen interest in all that pertains to the practical development of chemical applications. The speedy result has been an experimental demonstration of the availability of mineral-tanned Leather in Glasgow. This Company have, within the short space of *five months*, established a tannery, under the practical superintendence of Mr Charles Gallsworthy, from Leeds, where the whole process may be seen from first to last. Gentlemen connected with the Leather trade have gone to Glasgow from far and near to witness the process and its results, and, as we understand, from the Trade journals, have admitted the practical success of the invention. Some have been more enthusiastic in their words than others; but all have admitted the strength, the softness, and the remarkable resistance to wet, which the Chrome Leather exhibits.

And not only have the Company in the short time named, constructed their tannery, but we are informed that they have turned out two entire batches of heavy leather. Some of the samples of this Leather have been sent to us marked as follows:—

1. Calf skin.
2. Horse Butt.
3. Hide Butt.
4. *Grained Hide*
5. English Sole Leather.
6. Foreign Sole Leather.
7. Walrus.
8. Laces.

All these are well tanned, the lighter Leathers being remarkably strong, yet soft and pliable, and considering that they were curried in the tannery, promise under the operation of trade experts to become equal to the best bark-tanned Leather.

The producers claim for this Leather the following advantages which will rank under the heading of the various kinds of goods for which this Leather is fitted.

1. *Sole Leather.* Compactness, imperviousness, and great durability. For labourers, seamen, sportsmen, and others, these advantages must be invaluable.

2. *Machinery Belting Leather,* very tough and durable, and capable of withstanding a considerably greater strain than bark-tanned Leather can. After submitting it to the breaking strain of ordinary Leather it has the property of then becoming elastic, which should make it cling to pulleys and save the necessity of very frequently stopping the machinery in order to "take up" the belt. We have been favoured with, and give on next page, a copy of a certificate furnished by Lloyd's Proving House in Glasgow, showing the comparative strength of the new Leather as against the old. Two columns are added to bring out more clearly the comparative results.

As will be seen by careful perusal, this report suggests several considerations. It will be noticed that area and cubic capacity, as also the weight of most of the Chromate Leather are actually less than those of the bark-tanned, and that, notwithstanding this, the new article in every case surpasses the old in regard to strength.

We have also obtained a copy of a similar certificate granted by Mr David Kirkaldy, the proprietor of the well-known Testing and Experimenting Works, Southwark-street, London, which certainly corroborates very strongly the results obtained by Lloyd's Proving House. The bark-tanned Leather used in these experiments was procured, we understand, by Mr. Kirkaldy himself, from some of the best houses in London. We give, on page 358, the Table showing these results, from which it will be seen that the mean stress endured by the Chromate Leather is 4,477 lbs., as against 3,435 lbs. borne by the bark-tanned Leather, show-

ing a difference in strength of nearly $23\frac{1}{2}$ per cent. in favour of the Chromate Leather. Here are the tables:—

Description.	Dimensions.			Area.	Breaking Strain.		Weight.			Comparative Results.	
					Total.	Pr. sq. in.				Stronger by	Weaker by
	Inch.		Inch.	Sq. Inch.	Tons.	Tons.	oz.	dwt.	grs.		
Bark Tanned Eng. Bend.	3·92	by	·24	·94	1·375	1·462	6	9	8	...	15 p ct.
Chrome „ „ „	3·92	„	·22	·862	1·275	*1·479	5	14	14	15 p ct.	...
Bark „ Foreign „	3·92	„	·235	·921	1·1375	1·235	6	4	11	...	11 „
„ „ „ „	3·92	„	·23	·901	1·45	1·609	6	6	8		
Chrome „ „ „	3·92	„	·20	·784	1·6625	2·12	6	12	7	11 „	...
Bark „ Belting	3·92	„	·195	·764	1·35	1·767	6	10	17		
„ „ „	3·02	„	·255	·909	1·55	1·551	7	19	7	...	31 „
„ „ „	3·02	„	·215	·842	1·5	1·78	6	7	11		
Chromo „ „	3·02	„	·23	·901	1·875	2·081	6	3	19	31 „	...
„ „ „	3·02	„	·25	·986	1·80	1·825	6	17	21		

* See comparative area and weight, which prove this Sample of Chrome tanned Leather to be strongest by 15 per cent.

The table of comparative results has been made up by taking the weight of all samples into account in the same way.

September 17, 1880. (*Signed*) WM. FRASER, *Superintendent.*

TESTING AND EXPERIMENTING WORKS, 99 SOUTHWARK STREET, LONDON.

Results of Experiments to ascertain the Tensile Strength and Rates of Extension of six pieces of Chromate Leather and six pieces of Bark-tanned Leather.

	Dimensions.	Area.	Ultimate Stress.		Stress per Inch in Width.		
			Total.	Per sq. Inch.	200	400	600
	Inches.	Square Inch.	lbs.	lbs.	Per cent.	Per cent.	Per cent.
CHROMATE LEATHER.	8 by 28	2·240	7387	3297	8·48	14·44	18·72
	6 ,, 26	1·516	5629	3608	6·48	11·28	16·84
	5 ,, 25	1·250	4716	3772	9·68	13·00	18·88
	4 ,, 26	1·040	4364	4196	8·20	13·56	16·84
	3 ,, 25	·750	2992	3989	7·12	12·68	18·68
	2 ,, 22	·440	1774	4031	5·92	12·52	17·96
		Mean	4477	3815	7·64	13·04	17·99
BARK-TANNED LEATHER.	8 ,, 25	2·000	5314	2672	5·32	9·28	13·68
	6 ,, 19	1·140	3708	3252	5·80	9·52	13·64
	5 ,, 23	1·150	4459	3877	4·72	7·68	11·44
	4 ,, 20	·800	3283	4103	4·80	7·76	11·32
	3 ,, 20	·600	2156	3593	4·32	7·20	9·96
	2 ,, 21	·420	1661	3954	3·36	6·08	8·40
		Mean	3435	3575	4·72	7·92	11·41

As the thickness varied, each piece was measured at six places, and the dimensions given are those where fracture subsequently occurred.

Nov. 8th, 1880. (Signed) DAVID KIRKALDY.

3. *Hydraulic Leather.* The property of the Leather which admits of so much elongation, however, favours it very specially for cresses for Brahma presses, and all sorts of hydraulic purposes and pumps, for which it is with great difficulty that even the very finest of bark-tanned Leather can be got sufficiently pliable to be moulded into the requisite shapes. The imperviousness of the Leather also helps it specially for these purposes, as also for making water hose for fire-brigades, water buckets for steam vessels, cab covers, and all other purposes for which water-resisting properties are required.

4. *Card Leather.* Firmly retains the carding needles, and so supplies the desideratum of consumers of this class of Leather.

5. *Harness Leather.* Impervious to water, and very strong.

6. *Heavy and Light Upper Leather,* made from light Cow hides, North American hides, East India Kips and Calf skins, both English and foreign. The heavy Leather, it is claimed will answer the requirements of the Army and Navy, and from its imperviousness, softness and durability, and its capability of withstanding the rough wear and tear required in these departments of the public service, for which all boots have at present to be made from the best Leather. It is claimed also for the Leather that it withstands mildew, and is thus capable of being kept in stock unimpaired for any necessary length of time.

For light purposes the Eglinton Chemical Company do not seem to have produced anything equal to the fine French Calf as yet, but what they have produced, and especially the Horse Butts, is certainly very good indeed, considering the short time they have had to work the new system, and it is claimed for this light material that, owing to its imperviousness to water, feet shod with it will be as comfortable as if encased in the heaviest winter boots made from bark-tanned Leather.

7. *Sheep skins.* It has long been a desideratum with Colonial Sheep Farmers to have some simple process of tanning which would enable them to utilise the pelt or skin as well as the wool of the sheep which are now to such a large extent slaughtered for the manufacture of

preserved meat, and the Eglinton Company have been directing their attention to this branch of the trade. The sheep skins produced in their tannery have been tanned and dried in three days, and look remarkably well, though, of course, they are capable of that improvement which will doubtless result from larger experience; but so far as can be seen, the process promises to be of great service to our Colonial friends.

Besides being likely to be of immense benefit to our Colonies it seems to promise to have an important effect on the foreign salted hide trade, upon which all tanners so largely depend. The Eglinton Company, we understand, have been induced to arrange for the patents for South America and the Cape, chiefly in the hope of being able to show to the salters of foreign hides that by substituting Bichrome for salt they can with a very slight addition to their present salting plant, at a trifling extra cost, tan the hides instead of salting them, and so not only save the many hides which are spoiled in salting and shipping in the salted state, but put themselves in a position to command the market price for Leather. The prospect does not seem at all unlikely to be realised, and it certainly threatens seriously to affect the British Tanning Trade.

8. *Laces.* Soft and strong, much resembling the best porpoise.

As was to be expected some objections have been started against the new Leather, the two chief ones being that the tanning solution is not fast and will probably injure the feet. These objections seem to be amply disproved by the following certificate of the City Analyst in Glasgow, which we give in full. It will be observed that it actually proves that many times more tannic acid is extracted by water from ordinary Leather than the quantity of Chromium which can be extracted from the new Leather, and that it is positively asserted that the extracted Chromic acid cannot injure the feet. We would only remark as to this that one is apt to be deceived by the appearance of the water in which Chrome-tanned Leather has been treated, as an infinitesimally small fraction of a percentage serves to tinge a considerable quantity of water. The Report is as follows:

City Analyst's Laboratory,
138 Bath Street, Glasgow,
30th October, 1880.

Report upon six samples of Chrome-tanned Leather, received from the Eglington Chemical Co., Limited, on the 19th instant.

I have made a careful analysis of six samples of Chrome-tanned Leather, labelled respectively "Foreign Bend," "English Bend," "Hide Butts," "Strap Butts," "Buffalo Hide," and "Calf Skin," for the purpose of ascertaining the total quantity of Chromium which they contain, and the amount which is extracted by the action of water under different circumstances. The samples were cut into pieces about two inches square, and their Chromium contents are stated for convenience in the form of Bichromate of Potash.

	Foreign Bend, per cent.	English Bend, per cent.	Hide Butts, per cent.	Strap Butts, per cent.	Buffalo Hide, per cent.	Calf Skin, per cent.
Total chromium contents, calculated as Bichromate of Potash	3·30	3·47	3·97	4·80	6·18	3·50
Quantity extracted by boiling in water for half an hour...	·005	·048	·006	·018	·054	·006
Quantity extracted by steeping in cold water for 12 hours	·004	·019	trace	·006	·022	·060
Quantity extracted by steeping in cold water for 24 hours	·005	·027	trace	·007	·043	·077
Quantity extracted by steeping in cold water for six days	·014	·091	·025	·017	·135	·123

A sample of good bark-tanned Leather obtained direct from one of our leading tanners, when treated in a similar manner, gave the following results:

	Per Cent.
Tanning Material extracted by boiling in water for half-an-hour	2·13
(containing ·77 of Tannic Acid.)	

	Per Cent.
Tanning Material extracted by steeping in cold water for 12 hours	2·99
(containing 1·08 of Tannic Acid.)	
Tanning Material extracted by steeping in cold water for 24 hours	4·45
(containing 1·3 of Tannic Acid.)	
Tanning material extracted by steeping in cold water for 6 days	6·79
(containing 2·55 of Tannic Acid.)	

From the above results it will be observed that the quantity of Bichromate of Potash which I have been able to dissolve out of the samples of Chrome-tanned Leather, even by steeping in water for a week, is very minute, but even this quantity, small as it is, will probably become less by the reducing action of the organic matter on the Chromic Acid. In any case I am of opinion that the remaining Chromium compound in the Leather will not be dissolved out by any treatment to which the Leather is likely to be subjected, and cannot be hurtful to the feet.

JOHN CLARK, Ph. D., F.C.S., F.I.C.

We may, in a few sentences, indicate the process, as seen in Glasgow, with the further improvements that have there been introduced in the process by Mr Donald. The hides, when brought into the tannery, receive a dip in a water tank, and are afterwards thoroughly washed in a large revolving cylinder. They are next submitted to lime in the usual manner, the ordinary unhairing process being followed. The hides are then treated, in tan pits of the usual construction, with the chemical liquor produced from the bichromate, the liquor being used in different degrees of strength to suit the various hides and descriptions of Leather undergoing the tanning process. There are only some ten or twelve pits altogether (the number being thus greatly reduced), and in these pits is to be seen an application of Mr Donald's, which, it has been remarked by some of the leading tanners who have seen it, might with advantage be applied to all tan pits. This is the passing of a current of air through the tan liquor by a small pump worked by the engine. A constant commotion is thus kept up in the pit, and the tanning substances made to traverse the surfaces of all the hides in a thoroughly equal

and regular manner. The chemical process of conversion of hide into Leather by whatever agencies, bark or chrome, is thus greatly assisted by the agitation, and we understand that at least one large tanner from England, who visited the tannery, was so convinced of the merits of this invention that he resolved at once to introduce it into his own bark tanning pits.

In the course of a week or ten days the hides are thoroughly tanned so far as the chrome treatment is concerned. They are then submitted to a process by which the pores are made to absorb a quantity of paraffin wax in a particular form. The Leather is now ready for the curriers and dressers, the whole processes not occupying more than from three to four weeks. During the process of conversion into Leather the hides do not take on any dirt, and come out of the pits as clean as they went in, if not cleaner. This is a great advantage, as in ordinary tanning, in sole leather especially, a very large percentage of bloom has to be removed by laborious and expensive work. The finished Leather is made to suit all the purpose and have all the appearance of bark-tanned Leather, except that the yellow of the chrome colours the hide more or less, giving it in some cases a yellow, and in others a greenish hue, which, however, may be altered by modification of the process to suit the tastes of consumers.

We understand that, although Bichromate of Potash forms the real tanning agent in this process, the patentee has discovered that certain other substances form advantageous auxiliaries to it. These, we understand, are of a very simple character, and do not require any special skill in their application. The process moreover, as has been hinted, necessitates no change whatever to be made in the ordinary tanning plant, save in cutting off nine-tenths of the number of tanks or pits at present in use. We understand further that the whole of the tanning materials required average in cost overhead on all kinds of Leather no more than 2d. per lb. of finished Leather.

With reference to the time taken by the process, this varies of course according to the thickness of the hides. Walrus hides weighing 250lb. each and measuring nearly two inches in thickness, have taken to tan and finish less

than two months, as against four years by the ordinary process. Buffalo hides, which take eighteen months to two years by the ordinary process, are finished by this process in four to five weeks. *Heavy Sole and Belting Leather wholly* completed and ready for use in less than a month. *Light hides and Calf skins* all completed, tanned and curried in three to four weeks. *Sheep skins* in from two to three days. This points to an enormous saving to the tanners who have at present not only to take the risk of fluctuations in the hide markets during the long period when their stocks lie in process, but have also to employ a capital ten times as great as would be required by the new process.

In view of the extensive introduction of Chrome-Tanning, this element of cost is, of course, a very great matter. This desideratum is so completely met, that the figures supplied to the trade by the Eglinton Company need only to be generally presented to carry with them the proof of its superiority to the old and slow bark method. We may mention that, amongst others, a lot of 50 dry buffalo hides, which weighed, in from the market, 11 cwt. 15 lbs.. were turned out in three weeks; and, when finished and dried, weighed 18 cwt., giving a gain of over 61 per cent., and which by its excess over the gain in the ordinary process will more than repay the whole of the tanning materials used. When, further, we consider the saving in time, in plant, in wages, and on the interest of money, on a process complete in 20 to 25 days, as against a process requiring expensive treatment of from at least six to eighteen months, the benefits seem very large both to manufacturer and consumer.

With a view in some degree to meeting the curiosity of men practically engaged in Leather manufacture or in Leather working, we may give the following analyses of of results of this working which have been submitted to the trade :—

ENGLISH BENDS.

Average weight of Market Hides,		94	lbs.
,, ,,	Bends,	12½—25	,,
,, ,,	Shoulders,	11½	,,
,, ,,	Bellies,	12½	,,
Total yield of Leather,		49 lbs. or 52½ per cent.	

Time taken in liming, tanning, and drying, 25 days.

Calf Skins.
Tanned and curried in 21 days.

Waxed Russet Hide Butts.
Made from 40 lb. Market Hides.
For strong boots, perfectly water-proof.
Time taken to tan, 25 days.

Foriegn Bends.
Average weight of raw Hides, 57¾ lbs.
,, ,, Bends, 12¼—24½ ,,
,, ,, Shoulders, 12 ,,
,, ,, Bellies, 11¼ ,,
Percentage of Leather produced per Hide, 83 per cent.
Time taken to lime, tan, and dry, 26 days.

Grained Hides.
For Shooting Boots, perfectly water-proof.
Time taken to tan, 24 days.

Crop Hides.
Average weight of Market Hides, 94 lbs.
,, ,, Leather made, 51 ,,
Time taken to lime, tan, and dry, 27 days.
These were very heavy hides, and turned out more than 50 per cent. during the process of tanning.

Black and Brown Harness Hides.
Average weight of Market Hides, 94 lbs.
,, ,, Curried Leather, 45 ,,
Time taken in tanning and currying, 28 days.

Strap Butts.
Made from 11 lb. Foreign Bends.
Time taken to tan, 28 days.

Of course, in Germany the merits of the Chromate Leather have been severely canvassed during the time that it has been in the market. The force of use and wont, and the dislike of novelties, not to speak of mistaken views of vested interests, have had their own influence; but the number of tanners who have adopted the process, and the number of shoemakers on the Continent who are using Dr Heinzerling's Leather is daily increasing. At a very large meeting of tanners and shoemakers, held a short time since at Frankfort-on-Mainė, Mr Reuss, tanner, Aschaffenburg, is reported to have spoken as follows:—From the testimony of his customers in all parts of Germany; from all, in fact, who had bought the new Leather from him; from friends who had worn it as well as from tanners and shoemakers, he found they all were well pleased with the Leather. From his own

experience, he could inform the meeting that soles made from mineral-tanned Leather, and in constant wear since 28th August last, were still intact, while soles made from his own bark-tanned Leather would have required to be twice renewed in the same period. Tradesmen who had bought Leather from him had told him of similar experiences, and Messrs Heinzerling and Co. had received a great many certificates to the same effect; whether his hearers had made the same observations themselves he did not know, but the concurrent testimony of so many shoemakers who had worked the Leather and of people who had worn it was surely sufficient to show the importance of the subject. He was now in a position to execute to any reasonable extent orders for the mineral-tanned Leather; but he begged the gentlemen present not to suppose he wished to "crack up" his own manufacture; what he had stated was an impartial statement of his own experience, and he hoped they would not rest content until they had satisfied themselves by actual experience and observation of the truth of what he had said. Already a large number of shoemakers (not fewer than fifty in Frankfort alone, he believed), were working the Leather, and nine tanneries had now adopted the process. He might inform them that in Glasgow a tannery was being erected, and fitted up with every convenience for the manufacture of the Leather, by the Eglinton Chemical Company Limited, the large Scotch Bichrome manufacturers. There the Leather would be manufactured, and the whole process shown to tanners, and others interested in the Leather trade in England. The extraordinary strength, durability, pliability, and resistance to water of this Leather were proved by the testimony of brewers, sailors, fishermen, tanners, letter-carriers, foresters, &c., all of whom have had waterproof boots made from it, and have unanimously declared that they never had better boots on their feet, and that the Leather kept their feet thoroughly dry and warm. In addition to these advantages, there is also the price to be considered. The liming, hairing, handling, and currying of the Leather remain the same as in bark tanning, but the working and expense of the pits is saved; while, there being thus less capital required, less interest on outlying capital, and the tanning material

being cheaper, he had found that the Leather could be produced considerably cheaper than bark-tanned Leather. It had been objected that the Leather has an acrid, disagreeable smell; but though the smell is different, he could not admit that it was worse than that of bark-tanned Leather, and in a short time it wore off. A much more important consideration for the consumer was that the Leather does not spoil or decay as bark-tanned Leather does. While bark-tanned sole Leather gets dry and hard, and cracks if kept for any length of time, the mineral-tanned sole Leather gets better by age, and is not attacked by fungus, nor injured by wet. In a word, he might say the mineral-tanned Leather got better by keeping, the bark-tanned got worse. In conclusion, he observed that as the invention was yet in its infancy the process of manufacture was bound to go on improving, and even better results than he had stated might be confidently looked for, and he urged the gentlemen present to say whether the remarks he had made were borne out by their own observation and experience.

Mr Mondrion, President of the Shoemakers' Association, who is reported to have spoken with the utmost caution, said, that as his opinion had been asked for, he would say a few words. He was not opposed to the new Leather, but he wished to know better about it. All new inventions had a certain amount of prejudice to overcome, but it was not wise to shut their eyes and ears to new things, but rather to see and hear all that was going on. When the Leather was first introduced, there was much left to be desired in its appearance, but in the short time it had been before the trade very great progress had been made. On one side they were told that they must not let their existence be endangered and their trade threatened. He did not see that there was any fear of this. His customers had bought mineral-tanned Leather from him, but he had not found it necessary to charge a different price. He believed the opinion hitherto expressed was that the Leather was cheaper than bark-tanned, but he could not altogether agree with this. It was, to begin with, somewhat cheaper than bark-tanned Leather, but then it was somewhat more difficult to work, and setting one against the other the

shoemakers could not be expected to supply their goods any cheaper to the public. Speaking generally, he considered the mineral-tanned Leather a capital middling article. He would not say that, as produced at present, it was suitable for fine dress boots, but for ordinary purposes it was admirably suited. When people had a new material to work with, it was necessary to adopt new modes of working. He saw a workman here who had made dozens of boots from mineral-tanned Leather, and who could give them information about the working of it, but he feared he was no speaker. From his own experience he might say, let them get Leather where they would, they could not get it so good as the mineral-tanned. As he had stated some time ago at a meeting of shoemakers, he got calfskins from Paris and from Gera, which were excellent in quality and wear, but none of these could be put in competition with the mineral-tanned Leather. He had many customers whom nothing in the shape of Leather could stand. He had made boots for them from the Leather just mentioned (which, as they knew, was none of the worst), and in a few weeks he had the same boots brought back for repairs. For some of these customers he made boots of the mineral-tanned Leather, and although this was six months ago he had not seen one of them back for repairs. This was certainly a proof that the wearing qualities of the Leather were not to be despised. He had no more interest in the Leather than they had, but he must tell the truth. He came now to notice the remarks of some of the former speakers. Had they treated the Leather differently; had they, instead of throwing it into water, sat down upon it—(laughter)—they would have come nearer their purpose, as the warmth would have made the Leather work more easily. With a new material they must adopt new processes and apply new principles. In regard to blacking the Leather, Dr Heinzerling had discovered a method by which, as was proved before his (the speaker's) own eyes, the blacking could now be effectively done. One thing he would have them lay to heart. They were at the source of the supply; let them profit by this, and not put off till the Leather was brought from England. He could tell

them that before long mineral-tanned Leather from England would be in the German markets. They might not have any overweening affection for the new Leather, but he would advise them not to shut their eyes to its claims merely because it was new. As to the offal, he took it they were as well up to their trade as he was, and he had never had to throw away the offal. They knew as well as he did how the offal could be used up.

Mr Becker, Frankfort, again, was more enthusiastic. He said that in September last year he made for a cellarman a pair of boots with mineral-tanned uppers. He had worn them daily ever since, and they were even yet softer and more pliable than he ever had boots before. He will have nothing but mineral-tanned Leather now. For fine dress boots the Chrome Leather was not so well suited, but for strong boots it was excellent.*

From private persons, whose opinion is well worth respecting, many testimonies have been collected by the patentee and his very enterprising general agents, Messrs Wirth and Co., of which these are a few specimens:—

From F. COAX, *Inspector of Forests, Berne, Switzerland.*

Towards the end of April, 1879, I had a pair of double-soled lacing boots, for which Chrome-tanned Leather (Heinzerling's process) was used. The Leather I received from Mr F. Kilian, late Chancellor of the Government at Berne, and representative for Switzerland of the firm of Wirth and Co., Frankfort. At first I had some difficulty when blackening the leather in giving it a polish, but this difficulty was very soon got over. Later on I had the boots greased.

The Leather from the very beginning was smooth, and remained in that state even after frequently wearing the boots in dry or wet weather, on excursions, in the mountains, in the snow, and on the moors. The Leather became a little harder after many hours marching on glaciers and on wet ground, but after slightly greasing, it became soft again, and that without the boots having lost their original

* It is a well-known peculiarity of mineral-tanned Leather that it is well adapted for withstanding the effects of perspiration.

A. A.

"set." The Leather even yet shows no cracks or tears, and, so far as my experience goes, I have found that the Chrome Leather is both durable and agreeable to wear.

F. Coax.

From August Jäger, *Forester, Biedenkopf.*

For the last eleven months I have worn boots made from Heinzerling's Chrome-tanned Leather, and although I have had a great deal of walking through the snow at the winter hunt, &c., I have found the boots wear remarkably well. I never have wet feet with these boots, though melted snow is known to be very trying for Leather. My experience is that this Leather is more water-tight and durable, as well as softer, than bark-tanned.

August Jäger.

From A. Baldenecker, *Forester, Münden.*

I have worn a pair of boots made from Heinzerling's Chrome-tanned Leather the whole winter at the hunt, in rain and snow, without ever getting wet feet. I could put on the boots the following day, after being wet, without the Leather shrinking in the least. The Leather does not show in the least that it has been worn, although it has now been half a year in use. A. Baldenecker.

From H. Heinson, *Letter Carrier, Frankfort.*

Frankfort, *20th Jan.*, 1880.

I am highly pleased with my boots made from Heinzerling's Leather. Before this I used a pair of bark-tanned soles every month, but now I have been wearing the Chrome-tanned soles for about six weeks, and they are not yet worn through. The Leather kept the feet warm during the recent very cold weather, and proved quite water-tight in wet weather. H. Heinson.

From Jungst & Co., *Manufacturers, Biedenkopf.*

We have for two years used Heinzerling's Chrome-tanned Leather for driving belts in our spinning mills, and for this purpose it surpasses our expectations.

We have also had an opportunity of testing the Leather when made into shoes, and for this purpose it has given satisfaction. JUNGST & Co.

From GEORGE C. BRUHL, *Shoemaker, Biedenkopf.*

I have now worked for a considerable time with Dr Heinzerling's Chrome-tanned Upper Leather, and found same to be very good. It has the great advantage of not tearing when being tacked, as is often the case with bark-tanned Leather, and owing to its elasticity and toughness it keeps its form and has always a firm and easy grasp on the foot. GEORGE C. BRUHL.

From FERDINAND HOSCH, *Shoemaker, Biedenkopf.*

I find upon trial that Dr. Heinzerling's Patent Chrome-tanned Upper Leather is in every respect better than bark-tanned, being perfectly water-tight, tougher, softer in wearing, and its durability altogether surpasses that of bark-tanned Leather.

From my own experience, extending over more than a year, I can with confidence recommend this new Leather.
FERDINAND HOSCH.

From CARL KILIAN, *Merchant, Biedenkopf.*

I have worn no other Leather for a twelve-month except Heinzerling's Patent Chrome-tanned Leather, and I can say with perfect confidence that this new Leather wears remarkably well. It is in every respect superior to bark-tanned Leather, being softer and not liable to crack, and it is also perfectly water-tight. CARL KILIAN.

From W. OTTO HOSCH, *Brewer, Biedenkopf.*

Since New Year 1878 I have worn nearly daily a pair of boots made from Leather tanned by Heinzerling's Process. I never was in possession of such a good pair of boots; they are perfectly water-tight, and very comfortable, being soft and easy on the feet. I can hardly now wear another pair, even calf Leather, which I formerly liked best. I can only give Dr. Heinzerling's invention of tanning the best praise, and am sure that the bark-tanned upper Leather will have to give way to the new Leather.
W. OTTO HOSCH.

From all this it is quite evident that chemistry has brought a new and efficient agent into play for tanning, by which time may be saved, capital sooner set free, and therefore boots and shoes vastly cheapened. The enterprise of the Directors of the Eglinton Chemical Company, who have in a few months done so much to give practical shape to Dr Heinzerling's important invention, surely deserve no little praise; and we trust that they may thoroughly succeed in their efforts to get tanners throughout the country to take up the system and work it under their patent.

C. W. REYNELL, PRINTER, 16 LITTLE PULTENEY STREET, W.